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The view shows the Gatun locks as they will appear when completed, with the dam and the lake beyond. At the entrance are the emergency dams. Ships will be towed through the locks by four electric locomotives, running on tracks upon the side and center walls.

PROGRESS OF THE PANAMA CANAL IN 1911.—[See page 597.]

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Retrospect of the Year 1911

Civil Engineering.

IN any review of the engineering progress of the past year, the construction of the Panama Canal assumes the position of importance. Not alone is this the greatest single engineering work of its kind, but it is notable for the fact that it is being done at an accelerating speed, and will be completed long before the date predicted. In this respect, it stands almost alone among American engineering works of great magnitude. According to the report of the chief engineer, the Gatun dam will be finished during the summer of 1912; the locks at Gatun about the same time; the locks on the Pacific side in the fall of the same year, while the Culebra cut, and the channel entrances on each ocean, will be completed by July 1st, 1913, at which date, eighteen months before the time originally estimated, shipping will be able to pass through the canal from ocean to ocean. Next in importance is the New York State Barge Canal, upon which, during the year, satisfactory progress has been made. Practically the whole of the canal is under construction, and both the concrete work at the locks and the work of excavation are being pushed forward at a rate which gives promise that within a few years' time this valuable addition to the transportation facilities between the Great Lakes and the Atlantic seaboard will be open for service. The proposed Pittsburgh-Lake Erie canal has been brought again into public notice, and it is now proposed that its cost of fifty million dollars be divided between the three States which are interested, namely, Ohio, Pennsylvania, and West Virginia, the control to be vested in a joint commission. There has been a movement on foot in Russia to build a canal, with a depth of 14 feet, between the Black Sea and the Baltic, utilizing some 300 miles of the bed of the West Dwina and a thousand miles of the bed of the Dnieper. The estimated cost is $150,000,000. The greatest water-supply project in the world, namely, that for bringing the water of the Catskill region to New York city, has made great advance during the past year. The Ashokan dam is nearing completion; work upon the ninety miles of 17-foot aqueduct has been opened up upon many new sections; the wonderful siphon by which the water will be conveyed beneath the Hudson at Storm King is so far advanced that the vertical shafts on opposite sides of the river have been sunk to a depth of 1,200 feet, and the boring of the connecting horizontal tunnel is making good progress. The contracts have been let for the construction of the terminal tunnel which will extend the full length of Manhattan Island at depths of from 200 to 700 feet. Moreover, the prospects are that within a year or two, Catskill water will be fed to the Croton reservoir, whence it will be available for distribution in New York. One of the most beneficent and little-understood works of the United States is the reclamation by irrigation of arid lands. Already there has been invested about sixty million dollars in this work, and during the year it has been increased at the rate of about one million dollars per month. The scheme of reclamation includes the construction of some of the greatest dams and largest reservoirs in existence. Perhaps the most notable event in this work was the dedication of the Roosevelt dam, which was celebrated on March 18th. The structure is 282 feet 8 inches high, and it impounds sufficient water to cover 1,284,000 acres to a depth of one foot. At the present time, water can be supplied to about one million out of the three million acres which the completed scheme will cover. Another great hydraulic work in this country which has been advanced during the year is that of grading the Everglades in Florida, by which a vast tract of fertile swamp land will be brought under cultivation. In the field of bridge engineering, the most notable event was the letting by the Canadian Government of a contract for the construction of a new Quebec bridge to take the place of the one which failed so disastrously a few years ago. The structure will be what is known as the "K" web system, and the cantilevers will carry a Pratt-truss, suspended span, 640 feet in length. Nickel steel will be used in the cantilever arms; the suspended span; the anchor arms, and the members immediately over the main pier, together with the floor system, will be built of carbon steel. Toward the close of the year the contract was let for the construction of the four-track Hell Gate bridge, which will connect the Long Island Railroad system with the railroad systems of the main land. The most notable feature will be the main span of 1,000 feet, which will be the longest and heaviest arched span in existence. In the arch bridge alone will be 18,000 tons of steel, and it will take 70,000 tons for the whole structure, whose total length will be three miles.

Electrical Engineering.

During the year, the field of electrical engineering has steadily enlarged its borders. The progress has been in the direction, not so much of the development of new inventions and applications, as in the broadening of the scope of those already established. Undoubtedly, the most notable advance is that which has been made in electro-metallurgy and electro-chemistry. It is sufficient here to note the increasing application of electricity to the electrolysis of salts; the production of metallic aluminium and sodium; the production of calcium carbide, in all of which industries, and particularly the production of aluminium, the progress is by leaps and bounds. The refining of metals by electrolytic action has been responsible during the past year alone for placing over one hundred million dollars' worth of pure copper on the market. In the more novel applications of electricity to the arts, the electric reduction of iron ore has been the most prominent, and among the several ingenious designs of electric furnaces there are two or three which give promise of competing commercially with the present gas and coal furnaces. In the field of electric lighting, the tungsten lamp continues to win popular approval; and this can be readily understood when we remember that a 16-candle-power carbon filament lamp requires 56 watts for its operation, whereas a 20-candle-power tungsten lamp demands only 25 watts. It is gratifying to know that during the year the united efforts of the electric lighting companies have succeeded in producing a drawn-wire tungsten filament of great toughness and durability. In the field of transportation, electricity continues to be the supreme power for urban and suburban service, and note should be made of the fact that the Edison storage battery cars which have been operating during the year in New York city have been giving reliable and satisfactory service. The application of electric traction to steam roads is not making the progress which was expected when the New York Central and New Haven installations had proved how reliable and punctual a service could be given. Figures of cost are difficult to obtain; but, as the report on the proposed electrification of Boston suburban roads showed, the first cost of these changes from steam to electric power is so great as to discourage investments of this character. There is a consensus of opinion that the alternating-current, overhead trolley will be used for long distance service, and the direct-current, third-rail system for terminal and suburban work. The utilization of water powers by the construction of large hydro-electric plants continues to make a rapid advance, the most notable work of the year being the vast dam which is being built across the Mississippi River at Keokuk, Iowa. The dam will stretch for seven-eighths of a mile across the river, rising 32 feet above the river bed. At one end of the dam will be the lock gates and a power house 1,400 feet in length, in which will be mounted thirty hydraulic-electric units. The initial installation of 120,000 horse-power is to be completed in July, 1913. A promising field for the application of electric power is that of agriculture. It has been shown in the pages of the SCIENTIFIC AMERICAN what possibilities lie at the very doors of the farmer in the many abandoned mills and reservoirs, some of which, by a little reconstruction and adjustment, may be turned into central stations, from which power can be furnished to surrounding farms at a not prohibitive cost.

Railroads.

In the preceding section we have touched upon the progress of electricity as a motive power for steam railroads. The probability of the substitution of electricity for steam on the score of reduced cost of operation has been somewhat lessened by the extended application of superheat to locomotives. It now looks as though superheat will achieve those economies which, at least in American practice, compounding has failed to secure. The simple engine always possessed certain practical advantages over the compound, and the addition of superheat makes it possible to secure equal and often greater fuel economy in a locomotive of the simple type, than is possible in a non-superheat compound. The increasing application of superheat may easily be set down as the most important development in locomotive practice of the past year. In spite of predictions to the contrary, the weight and size of American locomotives, and, to a less degree, of foreign locomotives, continue to increase. To-day, in the huge engines built for the Santa Fe Railroad, we surely have reached the limit. A passenger locomotive for hauling fast passenger trains weighs 188 tons without the tender. The Santa Fe Mallet freight locomotive, with twenty-four wheels, twenty of which are drivers, weighs 308 tons, and with the tender, 425 tons, its length over all being 120½ feet. The fatal wrecking of the Washington express on the New Haven road, near Bridgeport, when it was taking a crossover, has drawn attention to the necessity of making crossovers from express to local tracks longer and of easier curvature, so that they may be taken at high speed without risk of derailment. Notable events of the year were the opening of the Pennsylvania terminal and tunnels at New York and of the handsome terminal of the Chicago & Northwestern at Chicago. Great progress has been made with the Grand Central terminal of the New York Central Railroad at New York. The excavation is nearly completed, and the greater part of the steel work of the station building has been erected. This terminal, with its total area of 69.8 acres, is equal in area to the four next largest terminals of the world, combined.

The Steam Engine.

In spite of the activity and great promise of its younger competitors, the steam engine, thanks to careful study of its principles and the best methods of construction, seems likely to hold its own as the principal prime mover for many years to come. The steam turbine, from the attitude of a competitor of the reciprocating engine, has passed into the position of its complement or useful ally. It is now understood that in the higher ranges of steam expansion, the reciprocating engine is supremely economical, just as the turbine is in the lower ranges. The installing of a low-pressure turbine between exhaust and condenser of the reciprocating engines, as we showed last year, increased the output of the New York subway power station 100 per cent, and increased the economy 150 per cent. Both on shore and at sea, the economic value of superheat is coming into increasing recognition, and economies of from 20 to 30 per cent and more have been realized in a wide variety of installations. An interesting development was made public during the year in the Tesla turbine, which consists of a series of flat steel disks mounted on a shaft within a casing, the steam being delivered at high velocity at the periphery of the disks and flowing between them in spiral paths, to exhaust through ports at their center. Tesla depends upon the properties of adhesion and viscosity of the steam for securing the desired torque on the shaft. A curious situation has developed in the United States navy, where there is an unmistakable disposition to return to the reciprocating engine as the drive for our future battleships. This attitude has resulted from observation of the sister battleships, "Delaware" and "North Dakota," and the economy of 30 to 40 per cent shown by the reciprocating engines

of the "Delaware" over the turbines of the "North Dakota," when the two ships were steaming in column during several thousand miles of cruising. The action of the department is, we consider, rather precipitate. The engines of the "North Dakota" are of a rather early type; more modern turbines would reduce the difference to 20 per cent, and a combination of cruising reciprocating engines and turbines would, we believe, wipe out the difference altogether, leaving the balance of practical advantages heavily on the side of the turbine-engined vessel.

Naval Development.

Toward the close of the year, there was mobilized in the North River, New York, at a few weeks' notice, the most powerful fleet that ever assembled in American waters. Over one hundred ships were drawn up in several parallel lines between the New York and New Jersey shores; and that the object of the Navy Department of popularizing the navy by showing to the people the actual ships themselves, was achieved, was proved by the vast throngs that flocked into the city from the surrounding country to witness the truly majestic spectacle. The most imposing element of the display was the line of twenty-six battleships, extending unbroken for six and a half miles, in which was included the six dreadnoughts that have been completed for the navy. Of more importance, however, than material, is personnel; and the significance of that array could be appreciated only by the naval man himself or by those who, like the writer, had been privileged to live aboard one of the ships of the navy when the fleet was engaged in the regular routine of daily life, and in the supremely important work of battle practice. In discipline, *morale* and practical efficiency, the navy has never stood as high as it does to-day. We have so recently devoted a special number to this subject, that it is sufficient for the purposes of the present review, to refer to the various articles in that issue, written by leading officers of the Department for the purposes of telling the people of the United States just what kind of a navy it is that we possess. The American type of dreadnought, with center-line turrets, and guns firing above the roofs of adjacent turrets, has become standard throughout the world; and the guns so admirably placed are being served so well, that we believe our ships are able to make accurate shooting at ranges that are never attempted by any foreign fleets. The one great fault with our navy is that it is not proportionate to the wealth and responsibilities of the country which it protects. The general board at Washington, after a conservative review of conditions, have decided that, in order to maintain a navy adequate to our wealth and population, we should build four ships (battleships or battle cruisers) every year. Our present inadequate increase of two battleships per year will, in five years' time, make it possible for our nearest competitor among the European naval powers to challenge the Monroe Doctrine, knowing that its strength in dreadnought ships, as compared with our own, is 100 per cent greater.

In a general review of naval development, there is noticeable a steady increase in the size of the battleship and the caliber of her guns. The largest ships have reached a displacement of 28,000 tons and over and carry 13.5 and 14-inch guns. There are signs of a reaction in favor of smaller ships, but we doubt if it will take place, so many and so great are the advantages conferred by the possession of big units. A noteworthy feature is the growth in popularity of battle-cruisers, ships of 28 to 30 knots speed, well armed, well protected, and with a large radius of action. We consider that the weak point in the make-up of our navy is its lack of any ships of this class. Our little 25-knot "Chesters" and "Salems" would be as defenseless in the presence of such vessels as so many chickens before a flock of hawks. They would not dare to venture within range of a screen of battle-cruiser scouts; for that would mean capture, or speedy destruction by 12 and 13.5-inch guns. Moreover, a squadron of 28-knot battle-cruisers would prove to be an extremely complicating factor in battle tactics, when used against an enemy which possessed no vessels of this class. The destroyer holds its own, and seems to increase in importance. Four destroyers to each battleship is a standard in European navies which we should make haste to follow. The submarine is increasing rapidly in size, offensive quality, and, most important of all, in sea-keeping qualities and radius of action. It is our belief that the submarine, or some modification of it, will see a development during the next decade which will possibly enable it to challenge the present supremacy of the battleship. Although the existing war between Italy and Turkey is necessarily, because of the practical absence of a modern Turkish navy, a military war, it has served to emphasize in a striking degree the importance of the command of the sea. Italy is not only able to localize the war in Tripoli, but is in a position to completely prevent the sending of necessary reinforcement and supplies to the Turkish army at the seat of war.

The Merchant Marine.

In any American who is possessed of a true patriotism, the subject of the American merchant marine must necessarily beget feelings of regret if not of positive humiliation. Year by year the flag of this country becomes scarcer upon the high seas, and it may truly be said that matters have come to such a sorry pass that unless this nation bestirs itself to a sense of its duties and opportunities, its flag must ultimately disappear from the seven seas. Let the facts of total tonnage speak for themselves. In 1789, the United States possessed 124,000 tons of merchant shipping engaged in foreign trade. In 1800, the total had risen to 667,000 tons. Sixty years later, we led the world, with a total of 2,379,000 tons. In 1910, the total had fallen to 782,000 tons, which is but a little over 100,000 tons more than we had afloat at the beginning of the nineteenth century. The one hopeful sign is the fact that the importance of the subject is continuously impressed upon the public mind. Out of the many suggestions which are being offered for the resuscitation of our merchant marine, there are two which seem to be practical, and would probably prove to be thoroughly effective. The first is the institution of a system of preferential duties in favor of American-built ships and against ships flying the flag of a foreign country. It was under this policy that the merchant marine of the young republic prospered in the first forty years of its existence, and we believe that like causes would produce like results in the present day. The other remedy, which is connected with the opening of the Panama Canal, proposes to bring all American shipping, sailing between Atlantic and Pacific ports by way of the Panama Canal, under the regulations which protect our coastwise shipping. Ocean-going steamships continue to increase in size, and it is an extraordinary fact that the increase is at an accelerating rate. When the "Mauretania" and "Lusitania," each 790 feet in length, were launched, it was predicted that the limit of size had been reached; but during the year there entered the port of New York, on her maiden voyage, a ship which is 882½ feet in length, and which exceeds the displacement of the two great Cunarders by from 15,000 to 20,000 tons, according to the degree of loading. In addition to her great size, the "Olympic" is notable for being driven by a combination of reciprocating engines and turbines. Her speed of 22 knots is, of course, considerably less than that of the Cunarders, which must remain the fastest of the trans-Atlantic liners until such time, possibly, as the internal-combustion engine has rendered a further advance in speed possible. The end is not yet, however, in this matter of size. The Hamburg-American Company is building two vessels, the "Imperator" and a sister ship, which are to be just under 900 feet in length; the Cunard Company is constructing the "Aquitania," which will slightly exceed 900 feet; and, in answer to our inquiry, the leading officials of the White Star Company inform us that an order has been placed with the Belfast firm for the construction of an 18-knot ship, 1,000 feet long, 100 feet wide, to be driven by combined turbines and reciprocating engines of 55,000 horsepower. The limit on length and size is placed by the length of piers and depth of harbor entrances, and before the "Olympic" could dock at New York, it was necessary to make a temporary extension of the pier (by permission of the War Department) of 100 feet, which, under the terms of the permit, must be removed in twelve months from the present time. From the earliest days of the modern steamship, attempts have been made to check rolling at sea. The most promising device to-day is that of Frahm, who has installed on several vessels anti-rolling water tanks, which apparently have done much to reduce this unpleasant source of discomfort to the sea voyager. The most important development in marine engineering just now, outside of that of increase of size, is the attempt to utilize the internal combustion engine for propulsion, a subject which is treated at fuller length in the present review under the head of the internal combustion engine. Mention should be made of the effort to reconcile turbine speed with propeller speed by the interposition of an intermediate reducing gear, the most noteworthy of which is the installation on the United States collier "Neptune," a 14-knot vessel of 19,300 tons displacement. The turbine running at 1,220 revolutions per minute, drives the propellers at 135 revolutions, through an intermediate, mechanical-reducing gear of the Westinghouse-McAlpine type, which has shown an efficiency of 98 per cent in a shop test. Trials of this vessel are still in progress. A sister ship to the "Neptune," the "Jupiter," is being equipped with a turbo-generator, running at 2,000 revolutions per minute, the power from which will be transmitted to the propeller shaft, with a speed reduction of 18 to 1, and an estimated efficiency of transmission of 91 per cent. Whether reduction gears or a combination of reciprocating engines and turbines will prove to be the better solution of the marine turbine problem, will probably be demonstrated during the coming year.

Internal Combustion Engines.

In the field of prime movers, the internal combustion engine undoubtedly presents the greatest promise, both as to the wide field of its application and the great reduction in space occupied and consumption of fuel per unit of work done. Although the producer-gas engine has given promising results, both in marine and stationary plants, it is to the heavy-oil engine of the Diesel type that the engineering world is looking for immediate developments. Because of its reliability and simplicity of operation, the Diesel engine has won recognition as the heavy-oil engine of the future. Nowhere is it holding attention just now so closely as in the navy and the merchant marine. For marine work it offers many and most valuable advantages. Tests on large engines of this type have shown the remarkable economy of 0.38 pound of crude oil fuel per brake horse-power hour, and the marine engines now in use average from 0.40 to 0.44 pound of fuel per brake horse-power when running under full load. In addition to fuel economy there is the great advantage that the space formerly occupied by the boilers and coal bunkers is free for cargo carrying or on warships for the installation of larger magazines, or, on warships, for the installation of larger magazines and store rooms. The fuel may be piped directly to the tanks and stored in the double bottom, a speedy and cleanly operation compared with the slow and dirty work of coaling a ship. The most notable marine installation is that aboard the vessel which is now being built by the Hamburg-American Line for their transatlantic service. This ship, of 9,000 tons, will be driven by twin engines, each of 1,500 horsepower, with which the ship is expected to develop a speed of 11 to 12 knots.

Astronomy.

By far the most noteworthy astronomical event of the year was the appearance of the new star discovered by Espin. Although the nova was actually first discovered on December 30th, 1910, the phenomenon may fairly be considered an astronomical event of 1911. The star proved to be a typical nova, which owed its sudden appearance probably to a collision between some orb, far in the depth of space, and a nebula or cluster of meteoric bodies.

The year was a year of comets. The body discovered by Kiess at Lick Observatory on July 6th was easily visible in an opera glass. Two weeks later, Prof. William Brooks, of Geneva, N. Y., the veteran comet hunter, discovered a comet which came within thirty million miles of the earth, and which proved to be a fairly conspicuous object. The return of Encke's comet was watched with interest, because it has the shortest period of any known comet, returning to the sun every three and one-half years, because it varies in brightness at each successive return in a very remarkable manner, and because its varying period of revolution proves that some other force than the attraction of the sun must act upon it. In the month of September two more comets were discovered, one by the Russian astronomer Beljawsky, and the other by Quinesset. Borelly's faint periodic comet, discovered in 1905, was observed on its return at some of the southern observatories.

On April 28th there was a total eclipse of the sun, which lasted almost five minutes—fairly long, as solar eclipses go. Since the whole track of the shadow lay in the Pacific Ocean, only a few islands were available as stations, for which reason the number of expeditions sent to observe it were not numerous. The usual observations were made, and no startling new fact was revealed.

Prof. Stebbins of the University of Illinois, who devotes his time to making very accurate measures of the brightness of the stars with an apparatus depending upon the change in the electrical resistance of selenium when light falls on it, took up the work of discovering new variables with his instrument. In this work he was successful, finding no less than two. Thanks to Prof. Stebbins, we have reached a knowledge of systems such as Beta Aurigæ, which it seemed almost impossible to have attained ten years ago.

Dr. Baker and Prof. Wendell showed that the star s Herculis is a close double with unequally bright components, revolving about each other in a nearly circular orbit in a period of 2 days, 1 hour and 13 minutes. Prof. Schlesinger, on the basis of the observations of Dr. Baker and Prof. Wendell, calculated the masses of the components, and showed that its distance from us is equivalent to 200 light years.

Aviation.

Startling advances have been made in aviation during the past year. In the middle of January, Eugene Ely flew from San Francisco to the cruiser "Pennsylvania," moored in the harbor, and alighted thereon, later returning to the shore. This was the first trip from shore to ship, and return, ever made by an aero-

(Continued on page 608.)

The Methods of Dust Extraction on Cotton-carding Engines

Safeguarding the Workingman's Health

By J. H. Crabtree

THE efficiency of cotton mills is intimately dependent upon the working conditions prevailing therein. Fresh, dustless atmosphere at a reasonable temperature is of paramount importance in promoting the welfare of the workers during their daily occupation.

How to clear the air in certain parts of these mills has for some time occupied the serious attention of employers. Several schemes, more or less effective, have been launched forth; but few have gone beyond the experimental stage. They are either too expensive, or impracticable on a large scale.

The common plan, until recently, was to install fans of 15 to 24-inch diameter in wall-boxes or window-frames, at various parts of the room, and exhaust the impure or dusty air so as to change the atmosphere of the room three or four times during each day. Dust is generated in most carding-rooms in such a degree as to be particularly injurious to the strippers. In card-rooms the raw cotton is combed, in machines known as "carding-engines," by a myriad of pointed wires attached to revolving cylinders.

A roll or "lap" of cotton is fixed on the front of this machine, and it issues from the back as a thick woolly band of yarn, with the fibers combed in one direction.

This machine makes the first semblance of a thread in the operations of a cotton mill. Between the lap and the thick yarn the cotton is passed over the cylinders covered with wires. Here the short fibers are held between the wires; the dust and small particles of the cotton-plant are also retained here. These millions of wire-points act much like an ordinary clothes brush. The wires thus cleanse the cotton, combing and preparing it for the "frames" which follow.

As each carding-machine has two cylinders, one of which is 4 feet wide and makes 160 revolutions per minute, it follows that in a few hours the wires become surcharged with dust and short fibers. And if they were not stripped of these they would be so glutted with refuse that the machine would fail to do its work. Hence, when the carding-engine has been in operation for two or three hours the process is stopped, and the two strippers bring up a cylindrical brush covered with wire bristles. This is placed in contact with each of the cylinders in turn, and revolved at a rapid rate.

The brush strips the wires of nearly all the short fibers which clogged up the interstices. It also roots out the dust and sticks which have been retained in the cotton up to its treatment in the carding-machine. When the stripping-brush has done its work, it is an easy matter to clean it by means of a hand-card. It contains short fibers only; the dust has passed into the air of the room in dense volumes.

Here, then, is the specific function of the new appliances—to prevent this dust pervading the air of the room. This is of greatest importance to the men who manipulate the brush. They must stand in close proximity while the brush is revolving. The volumes of dust pass into their nostrils, and much is unavoidably inhaled. This involves serious risk to the men, and in time, tells upon their physical strength. It is, indeed, seldom that strippers are able to follow their employment to a normal age of say 60 to 65 years. The work induces pulmonary troubles in some men at an early age.

The danger is, to some extent, mitigated where the men adopt the precaution of holding a tuft of clean cotton fiber, pressing it between the lips while stripping. This forms an old-fashioned respirator (Fig. 1), which is used daily by men who have often proved its value. Other men have recourse to specially-designed respirators, which are adapted to facial outline (Fig. 3), and preserve the mouth and nose from contact with dust. The fact that strippers have suffered acutely from their occupation has been definitely proved by investigations in various cotton towns where between 40 and 50 per cent have been found affected in varying degrees.

Fans, exhaust or indraught, have doubtless done much to purify the air of carding-rooms; but they do not touch dust-clouds for some time after the dust is generated. The result is that the dust becomes mixed with the air of the room and, after having affected the strippers close by, it is diffused in the room generally, and traverses the area where the women and girls are at work on the spinning-frames. There is a moderate amount of dusty material given off from the frames themselves in cotton mills. This in itself, however, does not occasion either inconvenience or injury. The new methods work on different lines from any before put into practice. Several of these are now in operation, but the general principle adopted is to collect the dust at the point of its generation and remove it by means of trunks to the external parts of the mill-premises or to inclosed dust-chambers.

Fig. 1. Simple and primitive respirator. A tuft of cotton held between the lips.

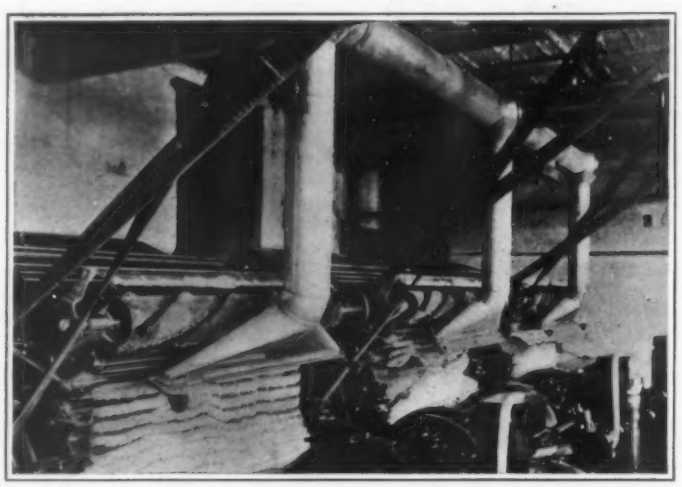

Fig. 2.—Fixed dust extractors in series.

Fig. 3.—Respirator specially designed for use by cotton-mill workers.

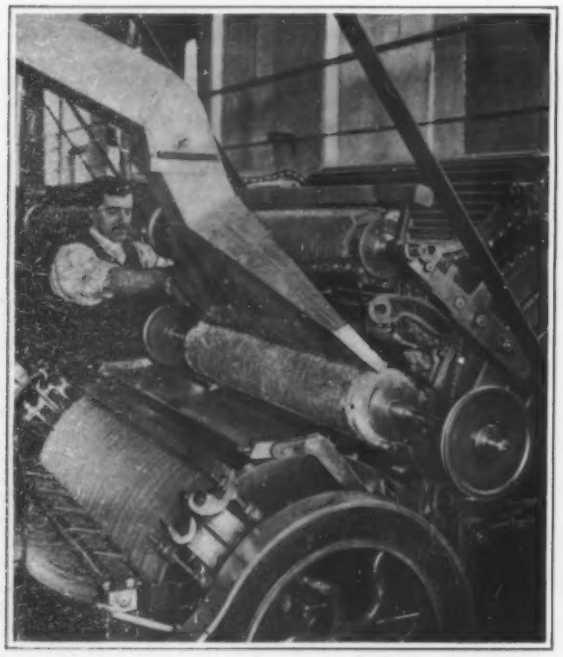

Fig. 4.—"Traveling extractor," with stripping brush over the main cylinder of the carding machine.

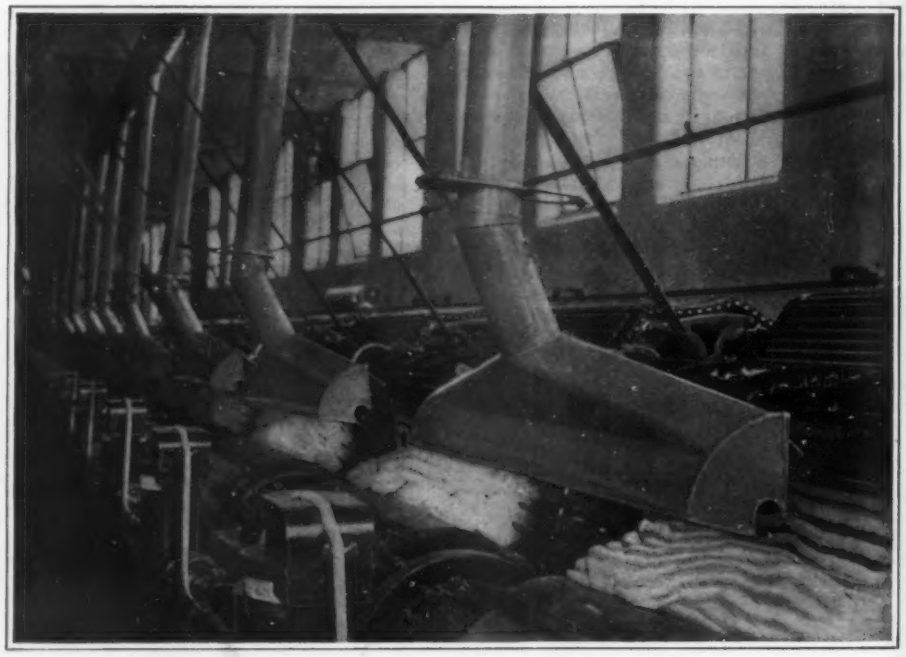

Fig. 5.—Another form of fixed "dust extractors" in series. When stripping is completed the hood is raised in the vertical tube.

THE METHODS OF DUST EXTRACTION ON COTTON-CARDING ENGINES

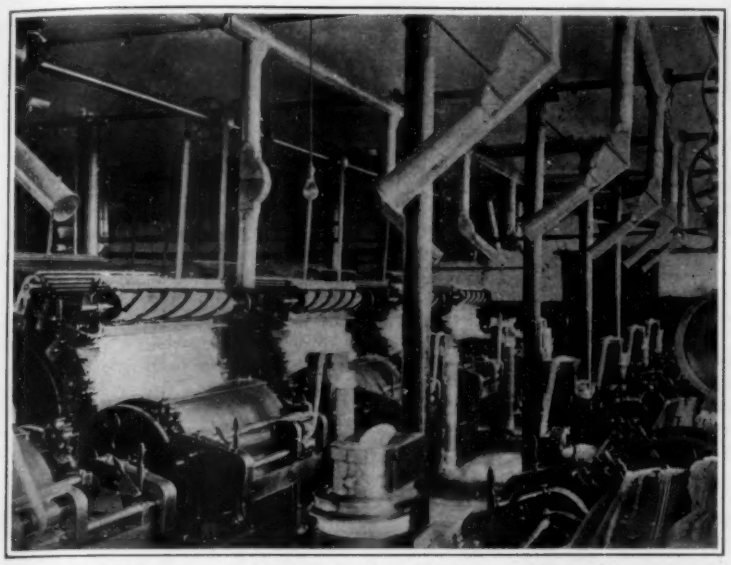

Fig. 6.—"Dust extractors" with automatic valves.

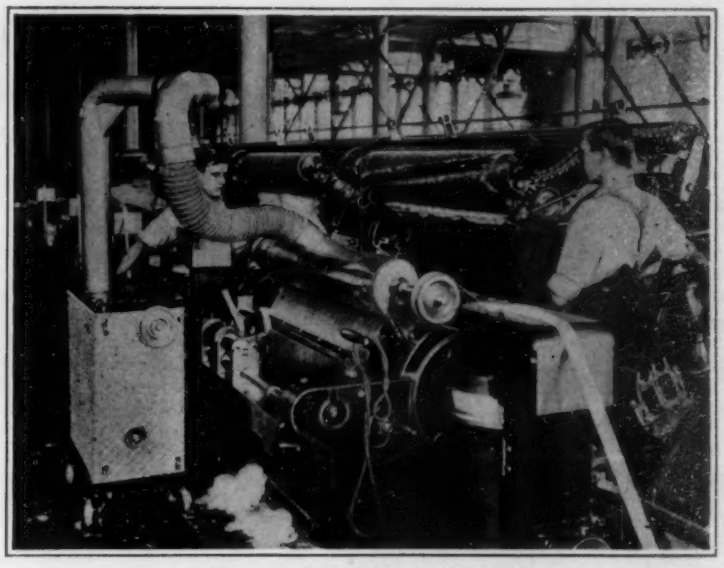

Fig. 7.—"Portable dust extractor."

THE METHODS OF DUST EXTRACTION ON COTTON-CARDING ENGINES

Several plans are at work in the cotton districts of Lancashire. By one of these (Fig. 2) a dust-receiver is fixed over each carding-machine. This is as wide as the machine itself and has an opening about 2 inches wide; it bears a balanced lid by which the aperture can be opened and closed at the will of the stripper. The receiver is attached above to a carrier-tube running to the main air-trunk. In this an inclosed blower runs at 1,200 to 1,500 revolutions per minute. The blower will take care of forty to sixty carding-machines, and the additional mechanical power used is nominal.

The *modus operandi* is as follows: When the strippers place the revolving brush on a carding-machine, the receiver-lids of the whole series are closed except the one over this particular machine. Thus the total exhausting force of the blower is concentrated on one machine; and when the stripping begins, the air-currents about the aperture are strong enough to gather the dust as it is generated. The attendants require no cotton tufts or respirators; the dust is completely prevented from reaching their breathing organs.

Then the receiver-lid is closed, the brush removed to the next machine, another lid opened, and the process is repeated throughout the series of fifty or sixty machines.

Another method (Fig. 4) has been devised, in which a single traveling receiver is available for each row of carding-machines. In cotton mills generally these machines are laid in parallel lines of ten to forty, with intervening spaces of 10 to 18 inches. It is therefore possible to build up carrier-tubes in line with the machines, and about four feet above them. On either side of the tube-line a rail is fixed to hold the grooved wheels of the traveling receiver.

The exhaust in this arrangement is maintained by a blower running at about 1,300 revolutions per minute. Over each carding-engine is an aperture in the

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New Tide-predicting Machine

By M. H. Talbott

UNCLE SAM'S new tide prophet is a machine which outclasses all human competitors; it is capable of doing in one day work which formerly required the services of sixty-five computers. It was invented by Mr. E. G. Fisher, of the United States Coast and Geodetic Survey, and is used to predict the height of the water at any instant on any date from one to two years in the future for every port in the United States and seventy of the principal ports of the world. This information is issued in the form of a book by the Coast and Geodetic Survey.

Tide predictions are based on local as well as astronomical conditions that influence the rise and fall of the ocean. At every port in the world there is an instrument which indicates these fluctuations by a curved line on a sheet of paper, and from a long series of such observed curves computers have evolved the average of each component at each place. The formula upon which this perfected machine is based includes thirty-seven of these components. There are a set of gears to represent the sun's influence, another to take the place of the moon, various other sets which act for the planetary movements, and still other sets which speak for local conditions.

The machine looks like a huge printing press. A skeleton frame of brass, steel, and iron occupies a space 11 feet long, 6 feet high, and 2 feet wide, and from the dial indicators in the front to the opposite end it is a maze of wheels, gears, pulleys, and chains.

There are three hundred gear wheels and pulleys in the machine. These are arranged in two main sections, one representing the time, the other the height of tide. Two chains, each permanently fastened at one end, run through each section, and their free ends are attached to indicating devices.

The operator beginning a set of predictions adjusts the eccentrics connected with each set of gears. By turning a crank he causes the wheels to rise or descend, thus lengthening or shortening the free end of the chain. This variation appears on the dials at the front of the machine, one pointer showing the height of water in feet and tenths; the other the day, hour, and minute of the occurrence. An electrical device stops the machine whenever a high or low water is indicated.

While the operator is recording these figures, the machine is doing a still more detailed work. A strip of paper 6 inches wide and 380 feet long is moving automatically across the face of the machine, and while one pen is marking the hours and exact times of highest and lowest waters, another pen is tracing a curved line which shows the gradual rise and fall.

The information turned out by this machine is sought by the marine engineer who wishes to calculate for improvements, and the hydrographic surveyor who is laying plans for future surveys, as it enables him to know the depth and time of high and low water on any date a year or two in advance.

A MACHINE THAT FORETELLS THE TIDES.

Weighting of Silk

IT is much to be regretted that many unscrupulous manufacturers resort to weighting, or "loading," raw silk in the dyeing process, to such an extent as to render it a very uncertain and treacherous fabric, with a tendency to split and crack even when carefully folded and laid away. In this dyeing process the natural gum of the silkworm is first removed from the silk by a method of "stripping," as it is called, in order that the raw material may properly take and hold the dye. This causes a loss of weight which dyers have always sought to restore, but instead of being content with doing this, the thrown silk is dipped into a solution of bichloride of tin, nitrate of iron, or some other chemical compound, for the purpose of giving it more weight than that lost in the stripping process, so that a hundredweight of silk in the raw state is often made to weigh three, or even four, hundred pounds when the dyeing is completed. As raw silk is bought and sold by the pound, the gain to the manufacturer is obvious. This operation makes the silk more valuable, but destroys the durability of the filaments.

Stretching the threads by steaming, so that a given weight will weave a greater number of yards, and the addition of chemicals to give it an unnatural luster, are other processes that prove profitable to manufacturers, but costly to consumers.

It is a mistaken idea with many people that the heavy silks are the best and most durable. Just the reverse is true. The light weight, or "pure dye silks," as they are termed, are much stronger and more durable, as only enough added weight is given to this class of silks, in the dyeing, to replace the loss in the stripping process.

The use of inferior and destructive dyes is another method equally as common and equally as reprehensible, by which many manufacturers impose upon the consumers in the dyeing of silk.

Charles Edwin Bessey

The New President of the American Association for the Advancement of Science

By Marcus Benjamin, Ph.D.

AFTER an absence of eight years the American Association for the Advancement of Science returns to Washington for its annual meeting. In 1903 the presiding officer was the chemist, Ira Remsen, who still guides with consummate skill the fortunes of the Johns Hopkins University. At the present meeting a botanist, who for forty years has faithfully attended the gatherings of the Association, will preside over its proceedings.

Charles Edwin Bessey was born in Milton Township, Wayne County, Ohio, on May 21st, 1845. His ancestry on his father's side is of French origin; for the Besses, as the name was formerly written, were Huguenots who fled from their native country to England and then about the middle of the eighteenth century Jacob Bessey came to America, settling near Doylestown, in Pennsylvania. In 1832 his grandson Adnah moved with his parents to Wayne County, Ohio, where later he married Margaret Ellenberger, of German descent, and there the son was born.

Young Bessey received his earliest education in the public schools of Ohio, and after preparing for college in the academies in Seville and Canaan he entered the Michigan State Agricultural College in Lansing where he was graduated in 1869 with the degree of Bachelor of Science, and where three years later he received a Master's degree. His intention on entering college was to become an engineer but he was advised to specialize in botany, which advice he reluctantly accepted. After much reflection, on so informing the president, he was told: "Well, Bessey, I am glad of it, but you'll never be rich," and then a moment later, "Yes, I am glad of it, but you'll never be rich." After graduation he was able to study his chosen specialty at Harvard, where he was fortunate in coming under the influence of Asa Gray from whom he acquired the foundations of the knowledge of systematic botany, especially in its philosophical aspect.

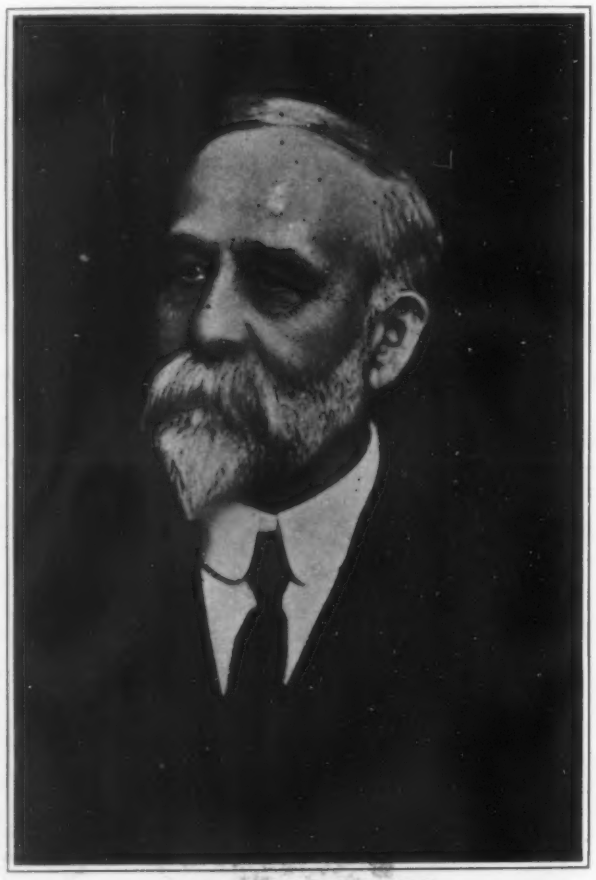
Preferment in those days was naturally in the direction of teaching and in 1870 he was called to the chair of botany in the University of Iowa where he continued for fifteen years, serving also as acting president during the year 1882. He accepted a call to a similar charge in the University of Nebraska in 1884, where he has since remained, being also head of the department. During 1885-1891 he was acting chancellor of the university, and again held this high office during 1899-1900 and during 1907-1908. He was dean of the Industrial College of the University of Nebraska during 1884-1888 and again since 1895; also during 1888-1891 he was dean of the College of Literature, Science and Arts of that university.

While botany has been his favorite study it has not been his only interest; for as he says: "In Iowa I began at once to write for the agricultural papers, telling people how to plant and what to plant; telling them about weeds and grasses; telling them also about insects and their bad habits; for entomology was one of my studies at that time." He joined the Iowa State Horticultural Society and read a paper on harmful insects, and took part in the first Farmers' Institutes held in Iowa during the winter of 1870-1871. On moving to Nebraska he was equally interested and at once began to collect information on the grasses of the State, reading a paper on the subject before the Farmers' Alliance; also presenting papers before such organizations as the Fine Stockbreeders' Association, Dairy Men's Association, Beekeepers' Association, State Agricultural Association, and the State Teachers' Association.

His literary activity has been very great; for besides many contributions to technical journals and papers read before scientific organizations he was for years botanical editor of the *American Naturalist* and has held a similar relation to *Science*. He was the editor of the botanical contributions, most of which he wrote himself, that appeared in the later editions of the New Universal Cyclopedia. Also he edited McNab's "Morphology, Physiology, and Classification of Plants" (1881). His principal works in book form are: Geography of Iowa (1876); Botany for High Schools and Colleges (1880); The Essentials of Botany (1884); Elementary Botanical Exercises (1892); Elementary Botany (1904); Plant Migration Studies (1905); and Synopsis of Plant Phyla (1907).

In honors, he has received elections to the Phi Beta Kappa and Sigma Xi societies, organizations in which membership is restricted to those who have done something. The degree of Ph.D. was conferred on him by the University of Iowa in 1878 and that of LL.D. from Iowa College in 1898. It may also be mentioned that he is a trustee of Doane College and he is a member of the Schoolmasters' Club.

Prof. Bessey is a member of many scientific and educational societies, as shown by the following list of organizations, in all of which he has been a prominent officer. He is a life member of the Botanical Society of America and was its president in 1896-1897; also he is a member of the National Educational Association, serving it as vice-president in 1896; and he is a member of the American Microscopical Society, of which he was president in 1902. His connection with the American Association for the Advancement of Science began with his election to membership at the Dubuque meeting in 1872. He was advanced to the grade of fellow in 1880, and has served the Section of Botany as chairman with the rank of vice-president, at the meetings held in 1890, 1902, and 1908. His long and valued connection with this foremost scientific organization in the United States gained for him the well deserved recognition of an election to its presidency at the meeting held in Minneapolis last December.



PROF. CHARLES E. BESSEY

President of the American Association for the Advancement of Science.

Opinions and Beliefs in Science

AS scientific experiments cannot be reproduced, authority necessarily remains our principal guide. In a remarkable book which bears the title "Opinions and Beliefs," the well-known French scientist Gustav Le Bon shows how large a part mere hearsay plays in scientific investigation. A scientist never publishes results which he does not suppose to be exact, but the influence of suggestion is so strong that even regarding very precise facts, an intelligent person may come under an illusion and take the visions of his imagination for realities. One of the most striking of this kind is the mischance to which nearly all of the members of the Academy of Sciences were victims about forty years ago. On the faith of an eminent mathematician, the assembly inserted in its proceedings about a hundred letters supposed to be written by Newton, Pascal, Galileo, and others. These had been made entirely by a forger of little education and were full of vulgarities and errors, but the names of their celebrated authors and of the scientist who presented them caused them to be accepted. Most of the members had no doubts about their authenticity up to the day when the forger avowed his fraud. When the prestige had vanished, the style of the letters was pronounced wretched by the same persons who before had praised them highly.

The recent adventure of the N-rays is even more typical, and brings out not only the rôle of prestige, but also of suggestion and mental contagion. Here we have to do not merely with experiments which are taken as faith by those who have no opportunity to verify them, but also with observations declared to be exact by a very large body of scientists who claimed to have repeated them. M. Blondlot, a leading professor of physics, observed, as he thought, that many bodies gave out special rays, which he called N-rays. These were detected mainly by their action on phosphorescence. Their wave-length could be measured very closely. What is most singular is that most of the French scientists working in this field repeated his experiments and saw exactly what was suggested to them to see. For two years the Academy proceedings were full of reports from scientists such as J. Becquerel, Broca, and Bichat on the wonderful properties of the rays, and Prof. D'Arsonval, among others, delivered lectures upon them. The French Academy wished to recompense such an important discovery, and delegated a committee headed by M. Mascart to make an official examination of the author's researches. The committee were much impressed, and thus a prize of $10,000 was awarded to the author.

During this time, however, foreign scientists who did not come under the prestige of the French savants, tried in vain to repeat the experiments. Then several of them decided to go to the author's laboratory to observe them. They soon found that he was the victim of a most complete illusion, for he would continue to make measurements of the supposed deflections of the rays, even when the "deflecting" was surreptitiously removed. The matter was carefully examined by a number of scientists, with the result that the specter of the N-rays was laid, once for all.

A few years ago an assistant in Prof. Lippmann's laboratory at Paris claimed to have discovered that an electrified body in movement did not deflect the magnetic needle (contrary to Rowland's experiment), a result which would have been of the highest importance for the theory of electricity. The author was not well known, but as the work was done in the presence of Prof. Lippmann, he had the benefit of his authority, and the question was discussed by physicists until a foreign scientist proved that the conclusions were erroneous and showed the reason why. In the case of the exact sciences the truth comes out sooner or later, as we have to do with real measurements and close observation. It is not the same, however, for sciences which are in a less developed stage, such as medicine; here it is very difficult to verify results, for we do not know what effects are to be attributed to suggestion or to the remedy itself, so that the errors persist for a much longer time. To enumerate them would be to go over all the history of medicine and show that theories, remedies and reasoning change every quarter of a century. About fifty years ago, the treatment of pneumonia by blood-letting was considered in France as one of the fine conquests of medical art, and its value appeared to be proved by statistics, which showed a mortality reduced to 30 per cent. Thus the remedy held its place until a doctor who visited a homœopathic hospital at London found that the mortality there did not exceed 5 per cent. This was a revelation. Instead of using diluted remedies, none at all were used, and soon the mortality in France fell to the same figure. To-day, instead of weakening the patient by blood-letting, he is strengthened by alcohol stimulants. This is a good example of the change in expert opinion. There is no need to multiply the examples, and it seems evident that the greater part of our scientific opinions should not be termed knowledge, but rather belief.

A Laboratory for Manufacturers

A German Scientific Institution That Tests a Manufacturer's Raw Material and Products and Gives Him Scientific Advice

By Waldemar Kaempffert

THIS is the first of a series of articles intended to show the part that science plays in German industry and commerce. The author of the article, Managing Editor of the SCIENTIFIC AMERICAN, *was sent to Europe by the publishers to study German industrial conditions with this object in view.*

A Saxon manufacturer of silk cravats found that his orders were steadily diminishing, although the season and the market were both in his favor. He made an investigation and discovered that his customers were buying silk cravats from a Prussian manufacturer at a price fifty per cent less than that at which he could produce them. To the Saxon's eye and touch the cheaper cravats were as good as his own. He could detect nothing in the material that could explain why cravats exactly the same in appearance should be sold at two widely different prices. He spent a month in thoroughly overhauling his factory. He found that he was buying his raw material at the lowest possible prices; that his wages were not higher than they should be; that his overhead charges were not excessive, and that his organization was good. Yet the fact remained that the Prussian was underselling him and was apparently making money.

The Saxon was an expert in cravats—at least he thought he knew all about them, because he had been making them for the better part of his career. Yet for the life of him he could not explain why it was impossible for him to compete with the Prussian. One day a salesman of his suggested that it might be well to have the Saxon and the Prussian cravats scientifically compared by the Koenigliches Material-Pruefungsamt—the Royal Laboratory for Testing Materials at Gross Lichterfelde, near Berlin. The examination would cost but little and might explain the mystery. As a manufacturer, the Saxon was convinced that he knew more about cravats than any scientist in any government testing laboratory, and that his trained eye and his sensitive thumb were more to be relied upon than lenses and chemicals. Still he consented. Samples of the Prussian and Saxon cravats were sent to Gross Lichterfelde. Two weeks later he received a formal report. His own cravats were pure silk. The Prussian's cravats were half genuine silk and half artificial silk (nitro cellulose). A chemist and a microscopist, neither of whom had ever made a cravat in his life, had not only discovered in an hour or two a deception that a manufacturing experience of thirty years had failed to note, but even revealed what particular process had been used in making the artificial silk employed.

The Technical Problems of Commerce.

It would not be difficult to relate a hundred instances such as this, all of them typical of the work done at the most remarkable testing laboratory in the world. At Gross Lichterfelde I saw not only cravats undergoing a rigorous scientific investigation, but chains, girders, paper, textiles, wood, dyes, copper, rubber, ink, typewriter ribbons—almost every kind of material that is used in our daily lives. Sometimes, as in the case of the Saxon manufacturer of cravats, the manufacturer was puzzled by a rival's success; sometimes he found himself with oxidized metal or faded goods on his hands, unable to discover the cause of the defects; sometimes he thought the customs officers had wrongly appraised his importations, because they had misjudged the character of the material; sometimes he wanted to know which of several raw materials should be employed for a specific purpose and was unable to decide himself.

The Royal Laboratory for Testing Materials works hand in hand with the German industrial. For a sum of money that must seem slight to Americans it places at his command a staff of two hundred and twenty-two men, seventy-two of whom are technically trained and the highest authorities in their respective departments of science. These men have at their disposal an equipment that includes the best obtainable apparatus for testing and analyzing any given material.

In Germany, indeed in Europe, the Laboratory is regarded as a court of last resort in matters involving the application of science to business. It is frequently difficult for a scientific man in the employ of a large corporation to deliver an absolutely impartial opinion on his firm's product. Inevitably there is a tendency to underestimate the products of a rival manufacturer and to view his own with favor. There is no such tendency in the Royal Testing Laboratory. Every chemist every engineer, every microscopist, every physicist, is a government official, and, as such, he is enabled to assume an absolutely impartial and judicial attitude toward the problem given him for solution. Indeed, impartiality is insisted upon, not only in the testing and examination of materials, but also in the phrasing of the reports submitted to an applicant for information. The manufacturer who can use one of the Royal Testing Laboratory's colorless opinions for advertising purposes would be miraculously ingenious. To restrain him, however, from exercising too freely what average ingenuity Nature has endowed him, and to prevent him from quoting with approval a report which is many years old and not at all applicable to his present goods, the Director of the Laboratory refuses to furnish certified copies of opinions more than one year old, and sometimes goes to the trouble of checking up advertisements in which reference is made to the favorable opinion of the Royal Testing Laboratory.

Scientists Who Study Factory Methods in Factories.

In order that the Laboratory may keep in close touch with industrial developments, members of its staff are sent from time to time to factories in order to study the exact manner in which textiles, cement, paper, ink, and the like are made. Thus, when it was decided to elaborate the equipment for testing caoutchouc and electric insulators, the exact manner in which rubber goods are made industrially was carefully studied, so that machinery could be designed which would enable a chemist or physicist to determine those facts which would be most useful to a rubber manufacturer. What manufacturer, for example, can tell definitely whether or not rubber goods should be stored in moist or dry rooms; whether that room may be indifferently hot or cold, dark or light; whether a rubber strip should be stored stretched or unstretched? These and similar questions Gross Lichterfelde will soon answer for him definitely, as the result of a long series of most practical experiments.

German manufacturers have not been slow to recognize the immense value of a government laboratory which solves for them the technical problems of commerce. A number of manufacturers of electric insulating materials jointly supplied the necessary funds for a painstaking study of insulating materials and of the insulating properties of rubber substitutes. The many compositions submitted were tested at various temperatures to determine their readiness of manipulation in the factory, their behavior under tension, torsion, and traction; their hardness; their ability to withstand exposure to weather and chemical corrosives. When the results of these studies are published, the Society of German Electro-Technicians will frame specifications for electric insulating materials, in which for the first time some admirable substitutes for rubber will receive their due.

How very impartial is the attitude assumed by the Laboratory is apparent when it is considered that manufacturers of competing materials may appeal for scientific information to Gross Lichterfelde at the same time. Sand-lime brick and clay brick are competitive building materials. Yet a powerful association of sand-lime brick manufacturers and an equally powerful association of clay brick manufacturers simultaneously consulted Gross Lichterfelde for the purpose of improving their respective bricks. The comparative tests which were made proved immensely valuable to both associations and gave the ultimate consumer a far better building material than he would otherwise have been able to purchase.

Perhaps the Laboratory has done its most efficient work in co-operation with the technical associations of Germany—associations of engineers, manufacturers and technical men. Thus in conjunction with the Society of German Cement Manufacturers, the Laboratory conducted an exhaustive investigation which has resulted in a scientific standardization of Portland cement, and has definitely settled such nice points as the influence of high temperature on concrete, the effect of copper, lead and zinc on cement, and the comparative merits of Portland cement and iron slag Portland cement. Similarly, in co-operation with the Society of German Bridge and Structural Iron Builders, a painstaking study of the strength of rivets in steel girders was made.

A Study of Paper and Ink.

It must not be supposed that all German manufacturers have been broad-minded enough to submit their products to Gross Lichterfelde for approval. An attempt to analyze the various kinds of automobile gasoline sold throughout the German Empire, and to induce the wholesale dealers in gasoline to standardize liquid fuel so that the motor car owner could buy gasoline in Southern Germany exactly similar in quality to that sold in Northern Germany, was met by a flat refusal on the part of the dealers to assist the Laboratory. It is only a question of time when the Laboratory will succeed in carrying out its plan. Similar opposition was encountered when Gross Lichterfelde was commissioned by the government to analyze German papers and to determine their availability for bank notes, public documents and the like, an opposition that may be understood when it was discovered that only a very small percentage of German papers were found to answer the government's requirements. As the result of the work done at Gross Lichterfelde, the German paper manufacturer has so far improved his product that rarely indeed has he failed to fulfill government conditions. Opposition to the scientific investigations of the Laboratory has given place to the heartiest co-operation.

It was but natural that after paper was studied for the government the thousand and one inks sold in the German market should have been carefully analyzed and tested to determine their chemical composition and their ability to withstand light, fire, and weather. That investigation has only recently been completed. The government can now specify with scientific precision the characteristics of a wellnigh perfect ink to be used on its wellnigh perfect paper.

The standardization of manufactures is thus undertaken only for the government. The Laboratory, as a government institution entrusted with the scientific examination of material used by the government, can dictate the requirements which that material must fulfill; but it would not set up standards for the manufacture of articles for ordinary consumption. When a manufacturer requested the Laboratory to determine for him the qualifications that an asphalt should have for insulating purposes, he was told that the asphalt industry must frame its own standards, but that the Laboratory would assist him by giving scientific advice.

A Scientific Court of Last Resort in Technical Disputes.

As an impartial institution for scientifically passing upon the commercial availability of manufactured products, Gross Lichterfelde is required by law, when requested to do so, to settle technical disputes. Instead of wasting time and money in asking the courts to decide whether or not a contract has been carried out according to the spirit and the letter, the disputants often submit their case voluntarily to the Laboratory for decision. A builder ordered a large quantity of roofing tiles and specified that they were to be waterproof. When the tiles were delivered he refused to pay for them on the ground that they failed to comply with the conditions of the contract. The dispute was submitted to the Laboratory for decision. The tiles were tested and it was found that they were sufficiently waterproof to come within the meaning of the contract.

Even if a case does go to court, the Laboratory may be asked by the presiding judge to decide the technical point at issue. The decision is binding upon both sides—a veritable boon to a court confronted with a mass of conflicting expert testimony. In one case it appeared that in the construction of a wall a stone composed of crushed slag had been employed together with lime mortar. The mortar failed to harden. The dealer who had delivered the slag stone insisted that the wrong kind of mortar had been employed. The mortar maker retorted that the slag stone was worthless. The experts summoned by both sides failing to agree, as might be supposed, the court submitted the whole matter to Gross Lichterfelde. There it was decided that the mortar had failed to harden, not because it had been made with the wrong kind of sand (as one expert had declared) nor because the slag was of the wrong kind (as another expert had insisted), but because many lime mortars harden only when exposed to the air, and then only after they have been alternately moistened and dried. Hence, said Gross Lichterfelde, the core of a wall, as in the case in question, is not likely to harden at all, whether or not a slag stone or good brick is employed.

In another case the court called upon the Laboratory

(Continued on page 609.)

The Heavens in January

Constellations of Southern Skies

By Henry Norris Russell, Ph.D.

THE star-maps published every month in the SCIENTIFIC AMERICAN represent the sky as it appears to an observer in the latitude of New York (approximately 40 degrees north) and consequently fail to show the stars within 40 degrees of the south celestial pole, which are visible only in lower latitudes.

To meet the needs of observers in the southern part of the United States, or in more southern countries, the accompanying map has been prepared, showing all the stars clearly visible to the naked eye, within 60 degrees of the south pole.

The whole region of the heavens here represented can be seen at once only from points in extreme southern latitudes. From stations north of the equator, less than half of it is visible at any one time. It is, however, very easy to adjust the map so as to show just what southern stars are in sight from any given station, at any day and hour.

We need only know the observer's latitude (which can be obtained with sufficient accuracy from any good atlas) and the sidereal time. The latter can be found closely enough for our purpose by adding together three numbers: 1, the local time as given by an ordinary clock; 2, the quantity given in the accompanying table for the current month; 3, four minutes for each day of the month to date.

	h.	m.
January	18	39
February	20	41
March	22	32
April	0	34
May	2	32
June	4	34
July	6	31
August	8	35
September	10	37
October	12	35
November	14	38
December	16	36

Midnight should be counted as 12 hours, 1 A. M. as 13 hours, and so on, and, if the sum exceeds 24 hours, this amount should be subtracted from it. For example, for 1:15 A. M. on October 25th, we have:

	h.	m.
Clock time	13	15
From table, for October	12	35
4 × 25 = 100 minutes, or	1	40
Sum	27	30
Subtract 24 hours.	24	0
Sidereal time	3	30

The results of this calculation will be correct within four or five minutes at the most, if the observer's clock keeps local time. If it keeps standard time, the result should be corrected by the amount by which standard time is fast or slow of local time. For our present purpose, this correction is usually hardly necessary.

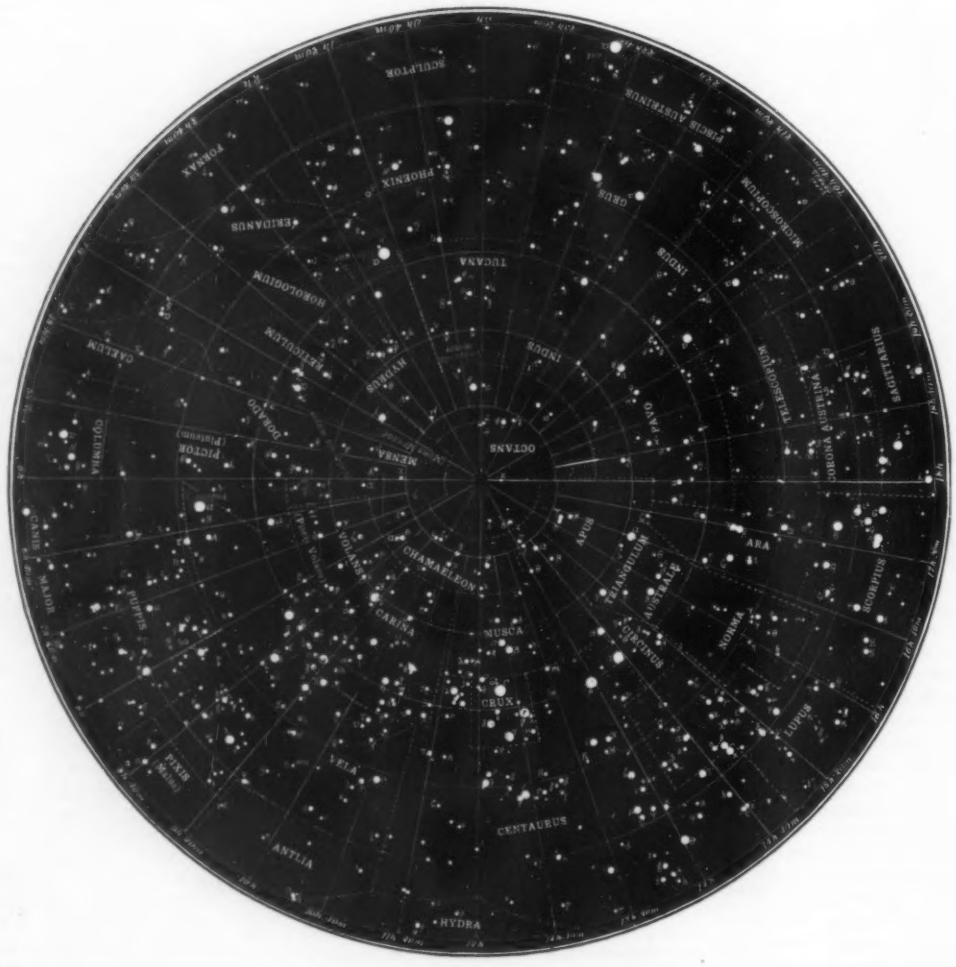
Find now the point on the margin of the map corresponding to the sidereal time, by means of the scale of hours and minutes on the edge, and turn the map till this point is at the top. Then lay a straight edge across it so that it passes above the center, at a distance equal to the observer's latitude (if north of the equator). As the white circles on the map are 10 degrees, 20 degrees, 30 degrees, etc., from the center, this can be done very easily. The part of the map above the straight edge then represents the southern sky, as it appears above the observer's horizon. In strict accuracy, the line representing the horizon should be curved, so as to be about one-third nearer the horizontal diameter of the map at the edges than at the center; but this too is of small practical importance.

For stations south of the equator, where the south celestial pole is above the horizon, the straight edge should be held below the center of the map, at a distance equal to the latitude. Stars in other parts of the sky than the south may be identified by the aid of the maps published every month. The present map is purposely made to overlap the southern portions of these by about twenty degrees, to facilitate passing from one to the other.

The familiar aspect of the northern heavens on a winter evening needs little description.

Orion and Canis Major blaze in the south, with Argo on the horizon below them. Gemini and Canis Minor are east and southeast of the zenith, Auriga directly overhead, and Taurus southwest of him. The planets Mars and Saturn, near together, between Taurus and Aries, increase the brightness of what is at all times the most brilliant region of the starry sphere.

Hydra, Leo, and Ursa Major are conspicuous in the eastern skies; Draco, Ursa Minor, and Cassiopeia in the north, and Perseus and Andromeda in the northwest. The only really dull region is in the southwest, which is filled rather than illumined by Pisces, Cetus, and Eridanus.



A CHART OF THE SOUTHERN HEAVENS

The Planets.

Mercury is morning star all through January. He is best seen about the 15th, when he is nearly 24 degrees from the sun. Being far south of the equator, in Sagittarius, he rises relatively late, about 5:45 A. M.; but he can be readily seen, before dawn, appearing as a star about as bright as Vega. Venus is likewise morning star, in Scorpio, rising about 4:30 A. M. in the middle of the month. Jupiter is a morning star, too, in the same region of the sky. On the 9th the two planets are in conjunction. Venus, which is about 1½ degrees north of Jupiter, appears about eight times as bright to the eye as he does, but in the telescope shows a disk little more than half as big. This very great difference in the apparent brightness of the surfaces of the two planets does not arise from differences in their reflecting power, but from the fact that Venus being relatively near the sun receives about fifty times the strength of sunlight that Jupiter does.

Mars is in Taurus, not very far from the Pleiades, and comes to the meridian at 8 P. M. in the middle of the month. He is rapidly receding from the earth, being 65,000,000 miles away on the 1st, and 88,000,000 on the 31st, and in consequence he diminishes steadily in brightness. At the beginning of the year he is twice as bright as Arcturus, and excelled only by Sirius, but at its end he is hardly equal to Capella.

Saturn is in Aries, about 10 degrees west of Mars, and appears about as bright as Procyon. His distance from the earth is so great—over 800,000,000 miles—that the forty millions by which it increases during the month makes but a small percentage of change in his apparent size and brightness.

Uranus is in conjunction with the sun on the 20th, and is invisible throughout the month. Neptune is in opposition on the 13th, and is well observable throughout the month. His exact position may be found at any time by interpolation between the two places:

	h.m. s.	deg. m.
Dec. 31..	7 37 58	+ 20 57.2
Feb. 1..	7 34 13	+ 21 6.2

This puts him very near the line drawn from δ Geminorum to a point found by carrying a line from β Geminorum through κ, and as far again. He appears as a star of magnitude 7.6, and can only be seen with telescopic aid.

The Moon is full at 7 A. M. on the 4th, in her last quarter at 2 A. M. on the 11th, new at 5 A. M. on the 19th, and in her first quarter at 3 A. M. on the 27th. She is nearest us on the 4th, and farthest away on the 17th. As the full Moon comes almost exactly at the time of perigee, we may expect unusually high—and low—tides on and about the 4th.

The Moon is in conjunction with Mars on the morning of New Year's Day, and an occultation is visible, in the morning hours, from points in the southwestern portion of the United States. She is also in conjunction with Neptune on the 4th, Jupiter and Venus on the 15th, Mercury on the 17th, Uranus on the 19th, Saturn on the 27th, and Mars again on the 28th, when a second occultation may be seen in the extreme north of this country.

A comet, visible in a small telescope, was discovered by the French astronomer Schaumasse on November 30th. It is moving slowly eastward through the northern part of Virgo, and increasing in brightness. On January 1st it will be in about 15 hours 15 minutes R. A. and 2 degrees south declination, moving about 1 degree east and 15 minutes south per day.

The first calculation of its orbit (by the discoverer and an associate) shows that it is still approaching the sun, and will not reach perihelion till February 5th, at which date it will be 108 million miles from the sun, and rather more distant from the earth. It will never be very near us, and in consequence may not be at all conspicuous; but it will be observable in the morning sky for some three months to come.

Princeton University Observatory.

Largest University in the World

REGISTRATION, now complete at Columbia University, shows that the attendance upon the university courses for the scholastic year is 7,468 as compared with 6,842 last year, an increase of 626, and, including the extension courses, the number is only eight short of 8,000. This places Columbia at the head of all other universities in the world in point of attendance, taking the place of Berlin, which stood at the head last year.

Progress of Work on the Panama Canal

Prospects of Completion by July 1st, 1913

THE original estimated date for the completion of the Panama Canal was January 1st, 1915. The work has advanced so rapidly that it has become apparent that the canal can be used at least a year earlier than this date. In order to determine the approximate time when shipping could pass through, a board was convened during the past year, composed of those charged with the work in progress and contemplated. Announcement was made that concreting of the locks at Gatun would be finished by June 1st, 1912, and the locks on the Pacific side four months later. Assuming that the gates were completed by June 1st, 1913, the contract time, the locks would be ready on that date, if the operating machinery were installed. The Gatun dam, it was estimated, would be finished by the close of the dry season 1912-1913, and if no more material, due to slides, had to be removed than was estimated at the time the board met, it was decided that the Culebra cut would be completed by July 1st, 1913. The exterior channels leading to the canal from the two oceans, it was found, would be sufficiently advanced to pass such shipping that would use the canal, by this same date, July 1st, 1913.

The report of Col. George W. Goethals, chairman and chief engineer, shows that progress during the past year has been eminently satisfactory. At Gatun locks, by the end of the fiscal year, the skeletons of four leaves of the gates were in position for a height of four panels, and those on the east chamber were completely riveted. At all of the locks, fender chains are to be placed 500 feet above and 230 feet below the upper and lower guard gates. When in use, they will be raised to the surface of the water, forming a barrier to the passage of ships. When it is struck by a vessel, the chain pays out against a resistance provided by hydraulic cylinders. The energy of a 10,000-ton ship moving four miles an hour will be absorbed after it strikes the chain before it reaches the gate.

Contracts for emergency or movable dams to check the outflow of water should the gates be carried away, have been awarded for $2,238,988, and all of these dams are to be completed by June 15th, 1913. Studies are being made of an electrical plant for operating the canal after completion, which contemplates a hydro-electric station on the Gatun dam, and a steam reserve generating station at the Miraflores locks.

A scheme for lighting the canal has been adopted. It contemplates the use of range lights for establishing the direction on the longer tangents, and of side lights, spaced about a mile apart, to mark each side of the channel. The project calls for the construction of 34 tower beacons of reinforced concrete, 57 beacons, 57 gas buoys, 76 spar buoys, and 7 nun buoys. There will be two parallel sailing lines, marked by range lights, which will be 250 feet apart; so that two passing ships, if on their ranges, will be 250 feet apart, center to center of ships.

Atlantic Division.

At the Gatun locks the excavation has been completed, except for a small amount at the north end of the lower locks. The concreting plant has shown great efficiency and capacity. The unloading cables have handled 500,550 cubic yards of crushed stone, and 241,858 cubic yards of sand. During the year, 945,525 barrels of cement were received into the storehouse, and in the same time an average of 6.08 of the eight 2-yard mixers furnished a total of 602,851 cubic yards of concrete. The total amount of masonry laid by the construction plant and by hand at the Gatun locks aggregated 911,137 cubic yards—a rate of 260.6 cubic yards per hour of service. The cost of the masonry was $6.64 per cubic yard. At the close of the year the masonry for the Gatun locks was 68.34 per cent completed. Over half a million cubic yards of backfilling was placed in the rear of the side walls of all the locks. A total of 31,060 feet of concrete piling was constructed for the foundation of the south middle approach wall, leading to the locks from Gatun Lake.

A total amount of 864,033 cubic yards of stone was crushed at the Porto Bella quarry at an average cost of 1.38 cents per yard, and from Nombre de Deos a total amount of 441,919 cubic yards of sand was obtained and transported in barges to Gatun, where it was transferred to the stock pile, at a cost, in the stock piles, of 1.86 cents per cubic yard.

Gatun Dam.

The Gatun dam has been formed by building two large rock embankments, and filling in the intervening space by hydraulic sluicing. During the year, on the east portion of the dam, the embankments have been raised from 65 feet to 85 feet above mean tide, and the hydraulic fill has been raised from 51 to 73 feet. On the west portion of the dam, the dry fill has been raised from 35 to 67 feet, and the hydraulic fill from 16 to 57.3 feet. The total increase of material, dry and wet, during the year has been 5,819,056 cubic yards. The cost of this work has been 38 cents for dry fill, and 23 cents for wet fill. The material for dry fill was brought by railway from Culebra cut, from the lock site, from Mindi, and from the spillway. The hydraulic fill was obtained from above and below the dam, and was placed by five suction dredges. The dam at the close of the fiscal year was 74 per cent completed.

Work on the spillway has proceeded very satisfactorily, and the concrete portion of the work is 66 per cent completed.

The channel between Gatun locks and the Atlantic is being attacked at several points, and 423,427 cubic yards have been removed between the locks and the Mindi hills. From the excavation through the Mindi hills 401,511 cubic yards have been removed by hydraulic dredge, and 280,000 cubic yards of earth and rock have been taken out by steam shovel. Between the Mindi hills and deep water in the Caribbean, the sea-going dredge "Caribbean," two dipper dredges, and three French ladder dredges have removed 4,516,369 cubic yards of earth and 487,038 cubic yards of rock, at a cost of 22 cents per cubic yard. The breakwater leading out from Toro Point has been pushed forward until, at the close of the year, 5,365 feet of double-track trestle had been completed, and 359,890 cubic yards of fill had been dumped from the trestle.

Central Division—Culebra Cut.

In the central division, the most important construction district is, of course, the great Culebra cut, from which during the fiscal year over sixteen million cubic yards were excavated, leaving, according to estimates of July 1st, 1911, about twenty-four million cubic yards yet to be taken out. The amount remaining has been increased during the year by 4,676,000 cubic yards, this to allow for the enormous slides which have developed, in the removal of which alone during the year, 4,880,000 cubic yards has had to be handled, which is over 30 per cent of the total amount removed from the cut during the year. The magnitude of this problem may be judged from the fact that thus far 10,757,000 cubic yards have been removed from slides, and the estimated amount remaining is nearly six million cubic yards. Col. Goethals states that slides follow the excavation in places where the material is left at a steeper slope than it will assume in its natural state; in which case it sloughs off until the natural slope is reached, and the movement ceases. Experience shows that it is only a question of time when these slides will cease entirely. Six of the good-sized slides are now quiet, and there is less trouble generally from this cause than at any time since the slides began to move.

A gratifying feature of this problem is the fact that, in spite of the enormous increase of 15,000,000 cubic yards of excavation due to slides, the reduction in unit cost, due to the splendid efficiency of the organization, will wipe out the extra cost of the slides, leaving the original estimate of excavating Culebra sufficient to cover the total cost of the work.

The average cost for excavation for the year was 59 cents per cubic yard, and at the close of the year the Culebra cut was 73.75 per cent completed.

Pacific Division.

The work of this division consists of the construction of the locks and dams at Pedro Miguel and at Miraflores, and the excavating of a channel between the locks, and from Miraflores locks to deep water in the Pacific. The total amount of concrete laid in the Pedro Miguel locks at the close of the year was 665,056 cubic yards, and the lock was 79.43 per cent completed. The locks at Miraflores, so far as the concrete work is concerned, are 19.27 per cent completed. As regards the channel between the locks and the Pacific Ocean, work has advanced satisfactorily between the two locks, and operations are being vigorously pushed upon the section lying between Miraflores locks and the Pacific Ocean. The dredges operating in the channel during the year were the 20-inch suction sea-going dredge Culebra, one dipper dredge, and three French ladder dredges. They removed from the channel a total of five and a half million cubic yards at a cost of 25 cents per yard, leaving a total of 4,700,000 cubic yards to be removed, including an estimate for siltage.

Towing Locomotives for the Gatun Locks.

By studying our front page engraving, it is possible to get a very accurate impression of the Gatun dam, with its spillway through the center, and of the massive concrete locks, through which access will be had to the Gatun Lake. The Gatun locks will be double, one set for ascending, and the other for descending vessels. They will be in three flights, and will have a total lift of 85 feet—this being the difference between the level of the surface of the lake and mean tide level of the Atlantic at this point. The locks lie some six miles from the Atlantic shore line, and the channel will be tidal up to the lower lock gates, with a small rise and fall of two feet—one above and one below mean level. (At the Pacific end, the rise and fall is 11 feet above and 11 feet below mean tide level.) The locks are the largest ever constructed, each having a width of 110 feet, and a usable length of 1,000 feet. Entering the canal from the lake, ships will find themselves guarded against running into the locks by fender chains which normally will lie at the bottom of the locks, but when a ship is entering will be stretched across the surface. As a further protection to the gates, there will be guard gates, placed some distance ahead of the main gates. These gates could be wrecked by an over-running ship without destroying the integrity of the canal and letting the water out of the lake.

Should a big vessel, becoming unmanageable, enter with such force as to carry away fender chain, guard gates, and the main gates themselves, an emergency dam is provided, by which the entrance to the locks could be closed. This dam consists of a massive swing bridge, which, in case of accident, could be turned so as to lie across the lock entrance. From the over-spanning bridge, a series of massive leaves of plate steel, extending entirely across the lock prism, would be lowered, gradually shutting off the flow of water, from below upward, until the wall of plates extended above lake level, when the entrance would be entirely closed.

Ships will not pass through the locks under their own power. Each ship will be taken in hand by four powerful electric locomotives, one off each bow and one off each quarter. The locomotives will each weigh 70,000 pounds. They will be driven by electric motors, operating gears which will engage a rack rail, and the hawsers from the ship will be attached to the windlasses of the locomotives, which will be provided with friction clutches, that will prevent the drums sustaining a pull of more than 25,000 pounds. The speed of the ships, when in tow of the locomotives, will be not over two miles per hour. The provision of rack rail traction, and the power and number of the locomotives, combined with careful operation, will practically eliminate any risks to the locks during the passage of vessels.

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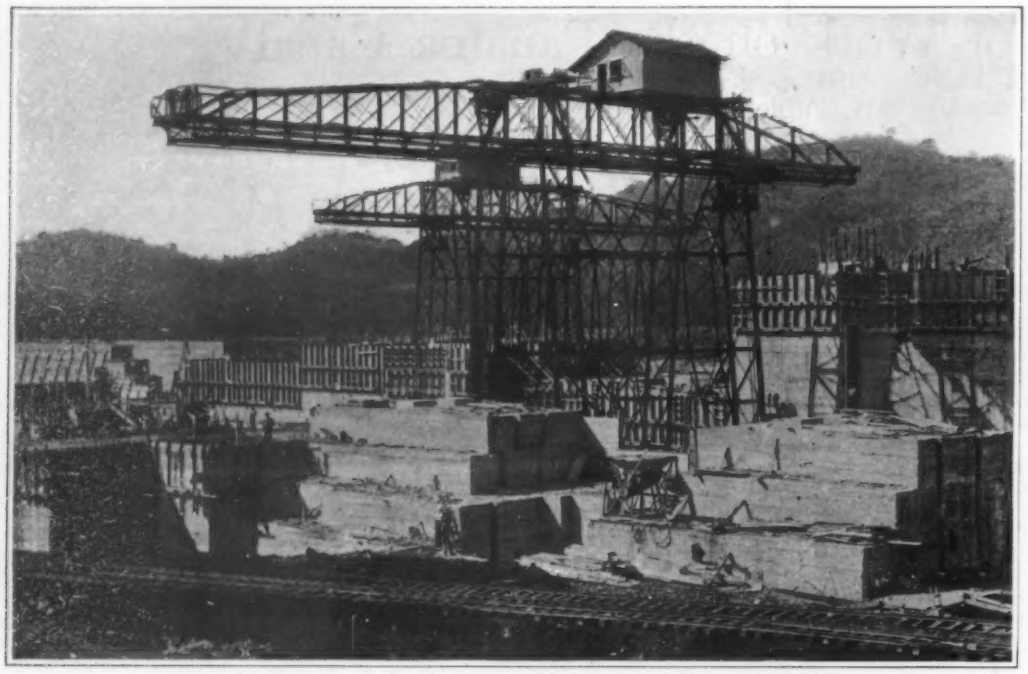
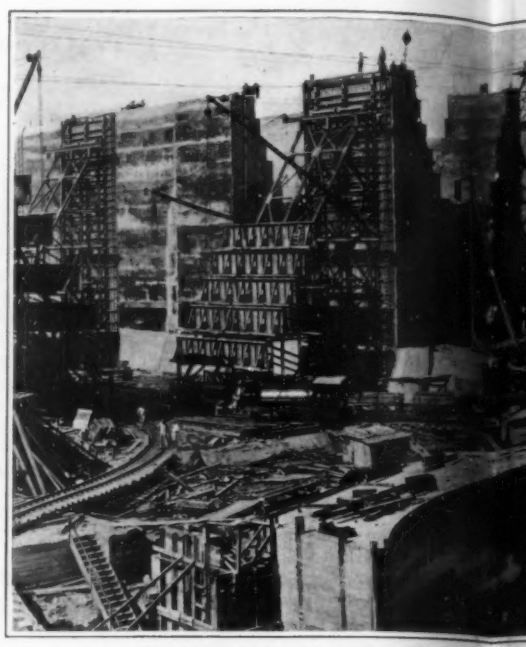
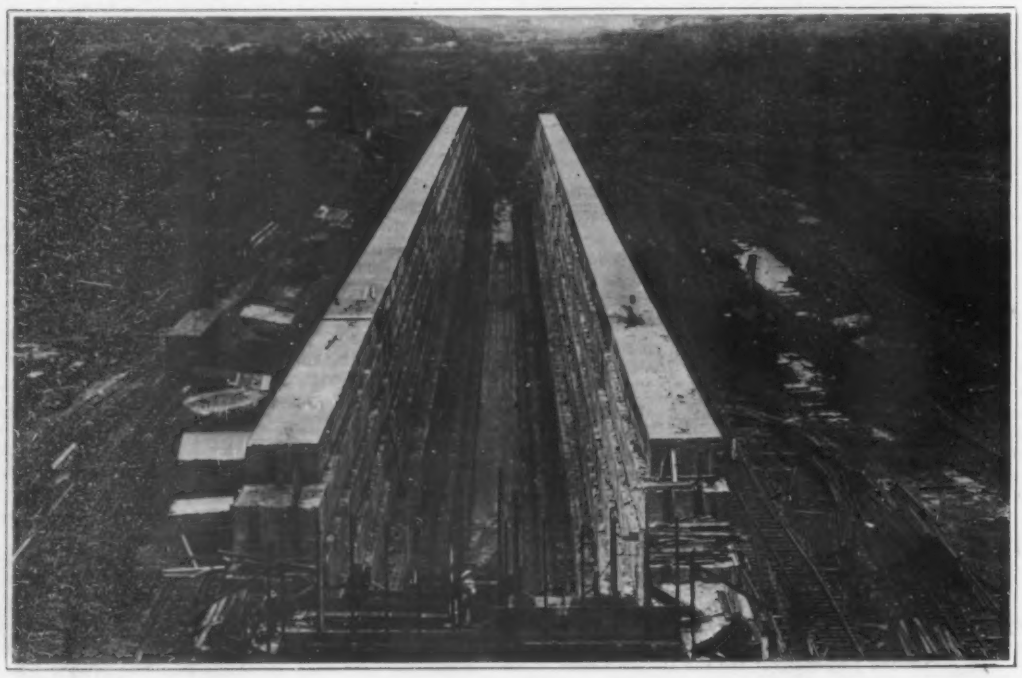


View of Pedro Miguel locks, looking west at intersection of center, and guide walls. The concrete walls are erected by means of the large cantilever crane.

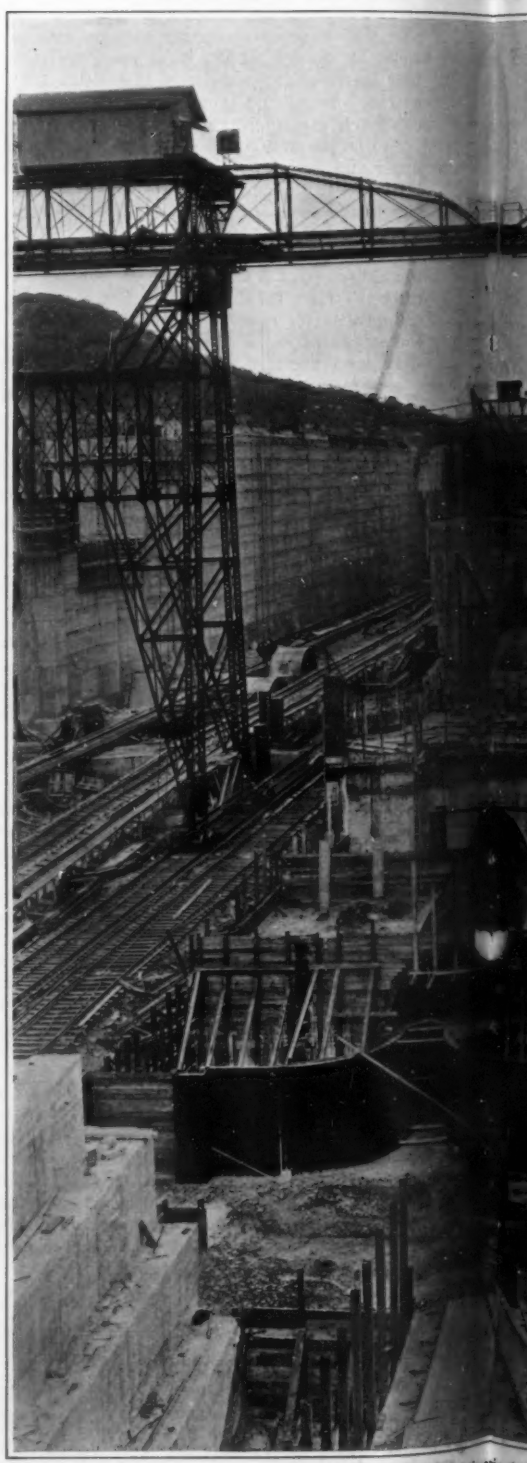


The Gatun locks. View showing south head walls

Looking north at the upper chamber of the east lock at Gatun. The bridge across the lock in the foreground is being used in connection with the erection of the gates of the lock.



Bird's eye view of one of the guide walls, looking south, taken from top of a chamber crane.



Pedro Miguel locks. View looking through lock along the axis of t

RECENT VIEWS OF THE

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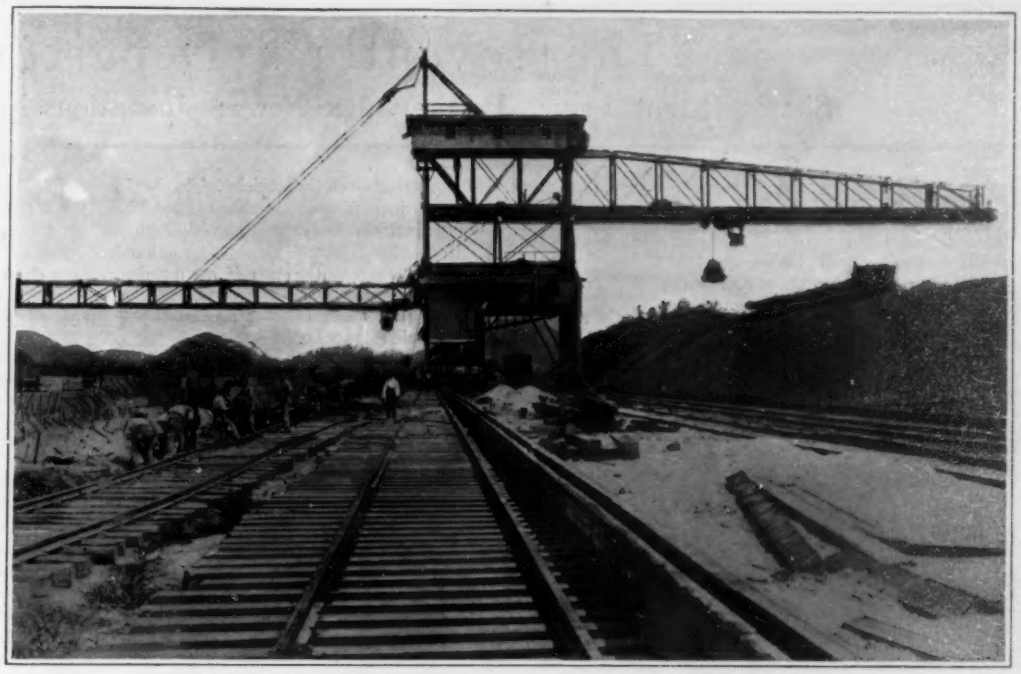
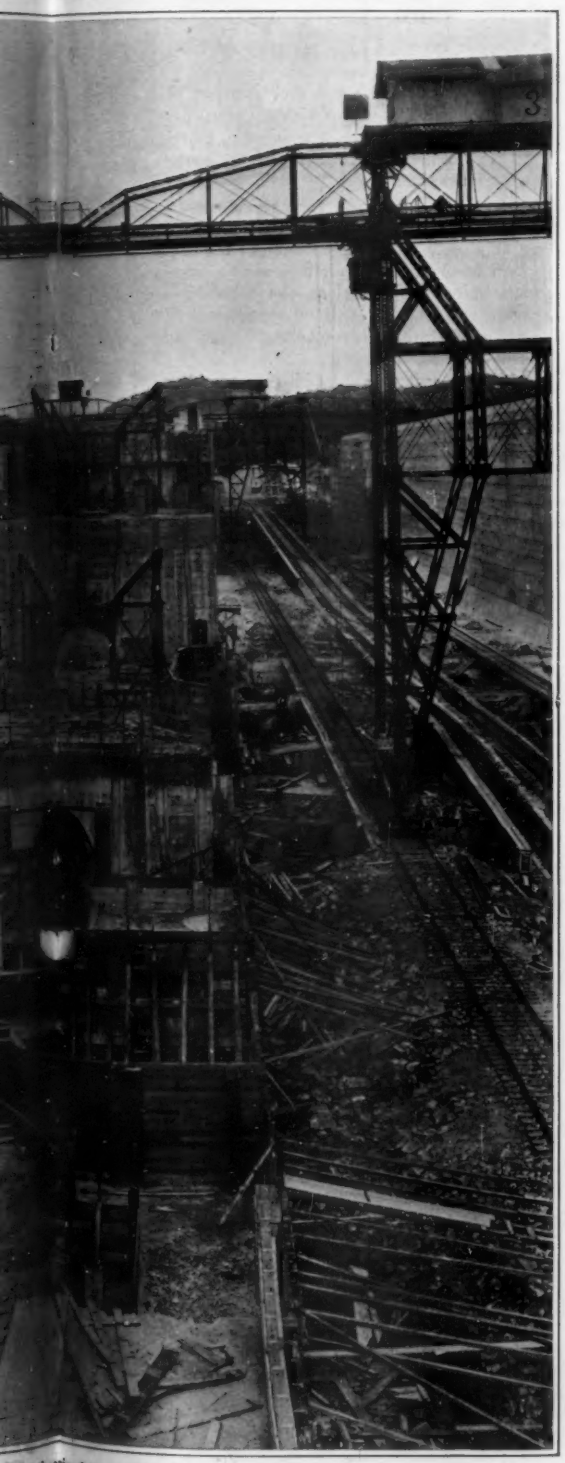
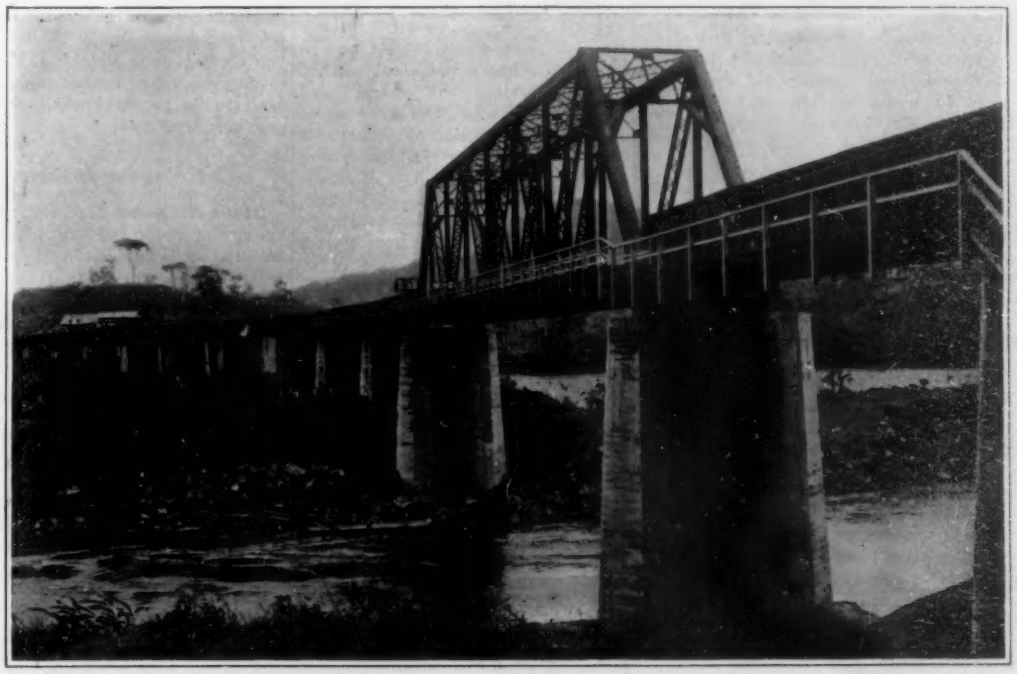
outh head walls for lower locks and end of middle lock.



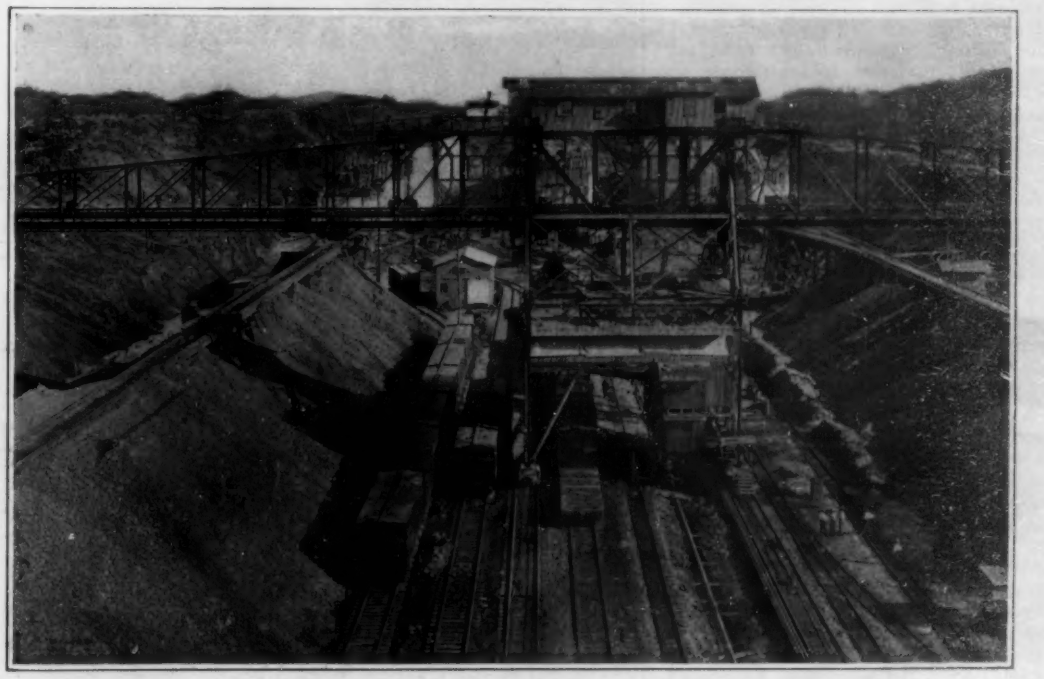
A view of one of the cranes at Miraflores. These are used for conveying the stone, sand, etc., from the stock piles to the mixers located in the base of the towers.



along the axis of the central dividing wall separating the adjacent locks.



View of Gamboa Bridge, a permanent structure across the Chagres River. The waters of Gatun Lake will back up to about ten feet below this bridge.



General view of Pedro Miguel locks, looking south, from the top of a crane that is being dismantled.

WS OF THE WORK AT PANAMA

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The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

A Typewriter for the Blind

IN view of the highly developed sense of touch in blind persons, the idea naturally suggests itself to construct a typewriter especially for their use, with the keys marked with the characters in raised type. A machine of this character, shown in the accompanying illustration, is the invention of M. Cayzergues, of Paris. Needless to say, when the operator has

A typewriter for the blind.

become proficient, the marks upon the keys are no longer necessary, and in fact the provision of raised characters upon the keys is the least of the special features required in a machine for the blind. What is needed is some arrangement whereby the operator is able to check up his work as he goes along and to correct any mistakes that may occur. With this in view, the machine which has been built is a combination of two separate printing mechanisms, both operated simultaneously from the same keyboard. One set of levers produces a record in raised characters on a paper cylinder, while another set at the back produces the usual written copy upon a separate sheet. The copy thus obtained represents the ordinary letter form as employed for business and other purposes, while the record on the paper cylinder is made in the special character used by the blind, consisting of a combination of small dots. In this way the blind writer is furnished on the one hand with a copy of his letter and on the other hand with a means for reading his writing as he goes along.

The new typewriter is not very much more complicated than the usual form. Each paper roller slides along a toothed rack in such a way that every time a key is struck, both carriages move along the distance of one tooth. The spacing of the lines is effected by hand by pushing a lever, so as to shift the roller carriages one space. The front carriage is arranged to operate the rear carriage through a rod and gear coupling. The raised record is so placed that the operator can run his fingers over it practically without interfering with his work.

When desired, the special mechanism for the blind can be disconnected and either part of the machine used separately.

Springless Truck for Rough Ground

THE accompanying engraving illustrates a very novel form of vehicle, which, by the use of eight wheels, dispenses with all springs, the wheels being so mounted as to enable it to travel over rough ground without being materially lifted by the obstacles over which it passes. A closer examination of the engraving will reveal the construction. Each wheel is mounted in a separate fork hinged to the frame above. The forks are connected in pairs by links running from crank arms on each to a common cross tree. As a result, should one wheel strike an obstacle, it would swing backward to clear the obstruction and in so doing would draw the cross tree backward, pulling its mating wheel forward. There would thus be a co-operative action between the two wheels in passing over the obstacle which would result in a practically level running of the vehicle body. Such being the case, there would be no necessity for springs. Of course, the truck body would not run perfectly level, but the rise and fall would be considerably less than with a four-wheeled truck of the ordinary construction. As most of the work done in drawing a vehicle consists in raising it over obstructions, it follows that the flexible wheel mounting here shown would call for much less tractive effort than is ordinarily the case.

Novel Cotton-picking Machine

THE machine which is pictured in the accompanying engraving is not completely automatic in its action. It is provided with a number of pickers, each of which must be separately controlled by an operator. The machine is driven by a three-horse-power kerosene engine, the entire outfit weighing about 800 pounds. The pickers operate somewhat on the principle of the spiral screw-driver. They consist of a shaft which rotates and at the same time has a reciprocal motion, so that it will alternately protrude and withdraw into a casing. The latter movement is produced by means of a guide with a double spiral groove. At the end of the shaft is a finger adapted to catch the cotton boll and twist it out of its pod, after which the picker is withdrawn within its casing, the boll is stripped from the finger and carried by means of an air blast through a cleaner that removes any leaves or sticks that may adhere thereto, and deposits the clean cotton in a bag. The picking finger is operated by means of a flexible shaft, while a separate flexible tube runs to the picker to convey the cotton to the cleaner. By providing individual control of the pickers, the cotton may be picked from parts of the plant which might be inaccessible to a purely mechanical machine. On a test with the cotton picker illustrated, two men being employed, a hundred pounds of cotton was picked per hour.

Cotton picking machine with hand-controlled pickers.

The springless truck thrown on its side to show the compensating wheel gear.

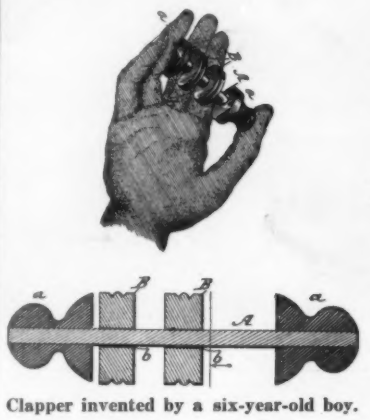
Youngest Patentee of Record

THERE is no age limit to patentees. Take the patent, No. 465,066, of December 15th, 1891, to Donald M. Murphy, of St. John, Canada. One might think from his X mark signature to the specification that Donald could not write his name, and he could not, for he had no book learning, but he did have the inventive ability to produce a sounding toy for which the United States Patent Office granted him a patent. But do not blame him for his lack of schooling, for Donald was only six years old when he filed the application, and as far as is known the youngest applicant for patent in this or any other country. His picture formed a part of the Patent Office Exhibit at the Chicago Worlds' Fair in 1893. The toy patented to him is a simple contrivance including a bar with handle knobs at its ends and two clapper disks slidable along the bar so they can sound against each other and against the handle knobs. See accompanying illustration.

Notes for Inventors

Death of Thomas Hall.—Thomas Hall, known for his inventions in connection with the manufacture of typewriters, died recently at the age of 77. He won a prize at the Paris Exposition of 1867, by the exhibition of a keyed typewriter. Mr. Hall also invented a number of sewing machine attachments and an improved drill grinder. He was born in Philadelphia, February 4th, 1834.

Fire Arm for Stage Use.—Most of us cannot shoot straight with a revolver designed for straight shooting, but to make sure of this John E. Banner, of Mt. Airy, N. C., has patented (No. 1,007,174) a shooting implement in the form of a revolver which has the muzzle end of the



Clapper invented by a six-year-old boy.

barrel closed and its bullet passage or bore deflected at its discharge upwardly and out through the top of the barrel so the bullet will pass almost vertically upward.

A Cloud Protector for Aeroplanes.—Army and navy ordnance experts are giving much time and thought to the best manner of attacking airships aloft. Various guns for firing at the fliers have been invented. "Is it not practicable," says one of our correspondents, "to provide some means, chemical or otherwise, by which the aviator can, at his pleasure, produce some cloud like vapor to envelope his machine and obscure it from the view of the enemy? The artificial cloud might be visible, but would only form a large target while the machine, the real objective point of the firing lines, would form only a small part of the target, decreasing in proportion to the size of the cloud the prospect of being struck by the projectiles."

Color Changing Flaming Arc Lamp.—Color effects in arc lamps are sought by a patent, No. 1,007,869, to Chas. W. Hill, of Lakewood, Ohio, assignor to National Carbon Company, of Cleveland, who provides an electrode for flaming arc lamps, in different portions of which are incorporated different substances, adapted as they volatilize, to give to the arc stream a characteristic color, thus imparting a succession of color changes to the arc as the electrode is consumed.

Prevents Hen from Setting.—Setting hens are proverbially persistent but Vern M. Osborn, of Los Angeles, in patent, No. 1,008,050, furnishes a poke like device which he straps on the hen showing setting proclivities, the device being provided with a pair of legs which project down in front of the hen's legs so that she cannot assume her usual posture on the eggs.

A Hewitt Vapor Converter.—Peter Cooper Hewitt of Ringwood Manor, N. J., has secured a patent, No. 1,007,694, for a vapor rectifier in which a cortainer has a conducting receptacle with hollow arms extending from it and conducting caps, constituting the terminals of the arms and forming the main positive electrodes of the apparatus, while the negative electrode is contained in the receptacle.

A Multi-blade Safety Razor.—A razor described in patent No. 1,007,847, granted to Axel Anselin Carlson, of Lindsborg, Kansas, has a casing and a blade guard. A carrier having a number of blades is revolubly mounted in the casing so that any one of the blades which are removably and yieldingly mounted in the casing may be brought into operative position relatively to the guard.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

DRYING AND STRETCHING FRAME.—C. WINKLER, 1646 Amsterdam Ave., New York, N. Y. This invention relates to apparel apparatus. It provides a frame more especially designed for drying stockings quickly and in pairs to prevent misplacing of mated stockings and to prevent the stockings from shrinking, the frame also permitting of convenient adjustment to readily accommodate stockings of different sizes.

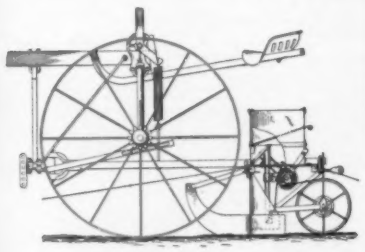
EAR MUFF.—W. H. FRENCH, Evansville, Ind. An object of this invention is to provide a strong and simple ear muff which serves efficiently to cover and protect the ear against the injurious effects of cold, wet, wind, etc., which is compact in form, and which is so constructed that it can be securely held in place without the use of a spring bow or other devices.

ELECTRIC TIME SWITCH.—C. J. LINDEWALD, 312 Dean Building, South Bend, Ind. An object here is to provide a device which is controlled by clock-work, and which may be set to close a circuit at any predetermined time, and to open the same subsequently at any predetermined time. A further object is to provide a device in the nature of an improvement to an ordinary clock for accomplishing the closing and opening of the switch.

Of Interest to Farmers.

COW STANCHION.—F. A. BRUNDAGE, Box 33, Belmont, N. Y. This invention relates generally to cow stanchions, and more particularly it involves an improved form of stanchion having means whereby the movable bar in the stanchion may be locked and unlocked. The stanchion has an improved locking means whereby the movable bar may be easily and quickly brought to either operative or inoperative position.

AUXILIARY PLANTER.—A. R. BALDWIN, care of Rogers and Baldwin Hardware Co., Springfield, Mo. The accompanying illustration shows a side view of a planter constructed and arranged in conformity with the present invention, pictured in conjunction with an independent hauling truck. The advantage is

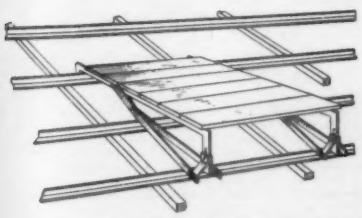


AUXILIARY PLANTER.

obvious, as it enables the planter to be used in conjunction with any other suitable farm implement. As an instance, it will be conceived that to attach a planter thus constructed to follow gang plows or harrows would serve to shorten the operation of preparing the field by just so much time, cost and labor as would be needed to plant the field after the bed has been prepared, as is the present custom.

Of General Interest.

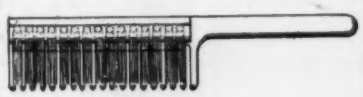
ADJUSTABLE BRACKET.—P. WHITE, 152 Academy Street, Long Island City, N. Y. This invention relates to a form of bracket for scaffolding, more particularly adapted for use by tile setters on sloping constructions. The objects of the inventor are obtained by constructing a bracket of a general triangular shape, having an adjustable hook depending



ADJUSTABLE BRACKET.

from one end to fit over a metallic framework of an unfinished roof, positioning two of these brackets apart on the roof and connecting the same by a scantling of board or boards to form a readily constructed bracket. The perspective view herewith shows an embodiment of the invention applied to a roof construction.

COMB AND BRUSH.—W. J. HOPE, Tunica, Miss. This invention is an improvement in a comb and brush, and the aim is the provision of a simple, compact and cheaply constructed device combining the functions of both instruments, as shown in the engraving, which will be capable of being carried in the pocket, will not easily collect dirt, and which may be easily cleaned. It is handled in the same manner as an ordinary comb. As the teeth pass through the hair, the bristles smooth the hair



COMB AND BRUSH.

both in front and behind the teeth. Either set of bristles may be used alone by inclining the comb, or the teeth may be used with both. Only a slight portion of the length of the teeth extends below the bristles.

GUITAR.—A. DEGULIO, 1261 Lynd Avenue, High Bridge, Bronx, N. Y. The invention relates generally to stringed musical instruments and more particularly it involves an improved construction of body of a guitar. From the engraving it will be seen that the bridge is supported entirely by the sounding board, being out of contact with the top of the body,

GUITAR.

this construction affording an increase in volume and an improvement in the tone of the sounds since the free vibration of the board is not interfered with in any way by the hands when playing; the vibration of the strings is transmitted directly to the sounding board and none of the energy of vibration is dissipated in through contact with the body since the bridge rests on the sounding board.

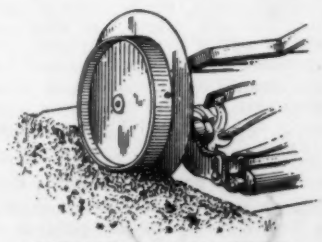
UNSINKABLE BOAT.—J. PASTOREL, P. O. Box, 947 Asbury Park, N. J. The frame is constructed of hard rubber and is covered with sheets of rubber or rubber cloth in such a way as to form independent air-tight compartments, inflated to increase the boat's buoyancy. Elasticity of materials used enables the structure to incur severe blows and shocks, because, when subjected to rough usage, the boat will

UNSINKABLE BOAT.

yield instead of breaking, as it might in case common material, such as wood or iron, were employed. The object of the inventor is to produce a vessel which will be lighter, faster and better able to resist damage than any other vessels of the same description. The engraving shows a side view of the framework.

Hardware and Tools.

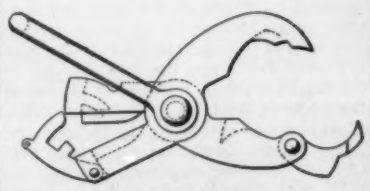
LAWN TRIMMING ATTACHMENT.—W. E. HILL, Charleston, Ill. It is the purpose in this invention to provide a lawn trimming or edging attachment of novel form and design, which may be detachably secured to a wheel of an ordinary lawn mower, as pictured in



LAWN TRIMMING ATTACHMENT.

the accompanying engraving, and when in position may be efficiently operated, with a minimum of time and labor required, to cut off all grass projecting outward over the edge or border of a grass plot, and to trim the face of the turf or sod in a uniform and symmetrical manner. The device may be operated by an unskilled operator.

SAFETY HOOK.—R. LANGE, care of Hugo Lange, Okanogan, Wash. This device is adapted



SAFETY HOOK.

to carry a load of cranes, or used as a harness hook or other readily-releasable connecting device suitable for carrying a load or resisting a strain. To this end the hook in general comprises two hook members pivoted together to swing to and from each other, one of the hook members having a gate adapted, when the hook members are closed and locked, to swing inwardly and permit the insertion and removal of the suspension link, the gate arranged at the mouth of the hook to take the strain on the link. The illustration shows the hook members released and swung apart.

Household Utilities.

BROILER.—J. W. TAYLOR, Box 93, Antigonishe, Nova Scotia, Canada. In this patent the invention has reference generally to broilers and more particularly it relates to those articles of this class which comprise a pair of extended body portions suitably hinged together and between which articles of food are held over the fire in order to be cooked, and held in a manner that will not permit the food falling out.

CONVERTIBLE CHAIR.—A. DEMERS, 461 Granite Street, Manchester, N. H. This invention has reference to convertible chairs, and it has for its purpose the provision of a rocking chair which may be readily converted into a cradle, a cradle member being normally dis-

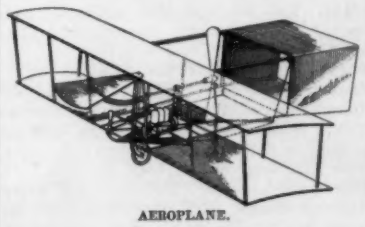
CONVERTIBLE CHAIR.

posed under the seat of the chair, which may be erected across the front of the chair to form the side member for the cradle, the sides of the chair being adjustably mounted so that they may be lowered to a horizontal position to form the head and the foot of the cradle. The chair is pictured in perspective in the accompanying illustration.

Machines and Mechanical Devices.

CHECK PROTECTOR.—C. H. SAMPSON, Rochester, N. Y. This invention refers to protectors employed for providing a check with a mark pressed into the paper and representing a certain sum, and the words "Not over." It provides a protector arranged to permit the user to view the line of the check where the printing is to take place, and to provide a single hand lever mechanism for controlling the movement of the printing parts.

AEROPLANE.—G. W. THOMPSON, Kingston, Okla. This invention relates to flying machines of the heavier-than-air type, and the object is to provide a machine of this class which has its propellers so arranged that they not only drive the machine but steer it also. By such a construction the inventor minimizes the necessity of using movable rudders here-



AEROPLANE.

tofore used to control the machine's course of travel. Balancing is accomplished by locating the power plant directly below the center of gravity of the supporting planes, and by the manner in which the planes are tilted with reference to the line of travel. The improved aeroplane is shown in perspective in the accompanying view.

FLYING MACHINE.—R. COLE, Norwalk, Ohio. This improvement relates to a flying machine, and particularly to aeroplanes in which an automatic balance of the equilibrium is obtained. A further object is to provide a flexible connection between the main supporting plane and the frame, whereby the equilibrium of the aeroplane is automatically maintained.

FLUID PRESSURE TOOL.—A. C. MCFARLANE, 601 North Wahsatch, Colo. The object of this invention is to provide a fluid pressure tool, arranged for running the tool at a high speed and with economy in the use of the motive agent, to reduce jar and vibration to a minimum and to prevent breaking of the operating parts, especially when the tool is running without the drill being in place.

WINDMILL.—C. F. CRADDICK, 514 W. Porphyry St., Butte, Mont. The accompanying engraving shows a side elevation of a windmill constructed and arranged in accordance with the present invention. The principle objects in view in this case are: to provide a power head for a windmill disposed and ar-

WINDMILL.

ranged as a series of turbine-shape rotating members; provides a power head having a maximum wind pressure surface disposed in power relation to the wind, and having the maximum of exposed surface when disposed in angular relation to the wind; and to provide regulating means for automatically varying the pressure under operative conditions.

Prime Movers and Their Accessories.

ELASTIC FLUID TURBINE.—R. HARRISON, 58 Chancery Lane, London, England. In this patent the invention has for its purpose the production of an efficient turbine of simple and strong construction having the steam nozzles, exhaust openings, and connecting channels so arranged that the work to be done by the steam shall be distributed over two or more stages arranged around the circumferenec of a single rotor.

CARBURETER.—W. A. HARRIS, 217 John St., Greenville, S. C. The invention in this case is an improvement in carbureters, and the purpose of the inventor is the provision of a carbureter of the character specified, for use in vaporizing gasolene and mixing air therewith in the most favorable proportions for the most efficient combustion.

Railways and Their Accessories.

RAILROAD TIE SPACER.—J. W. WOOD, Needles, Cal. In the present patent the invention is a spacer for railroad ties, and it comprises a device which can be readily placed in position to grip the top of a rail, and which acts as a fulcrum for the spacing bar which is used to force the ties into proper position.

BRAKE BEAM AND FULCRUM THEREFOR.—J. B. SIMPSON, Easton, Pa. This improvement refers to brake beams and fulcrums therefor, and it has for its object to provide a fulcrum member having means by which it may be conveniently secured to a T-shaped or other beam, without slipping the fulcrum over the end of the beam, and without splitting the fulcrum member.

Pertaining to Recreation.

TRAVELING ROCKING HORSE.—W. ROBERTS, 702 W. Mulberry St., Springfield, Ohio. This improvement has reference to traveling rocking horses and the object is to provide one which is propelled by means connected to a rock shaft to which the horse is secured, stirrups being provided which are connected with steering mechanism by which the direction of travel may be controlled.

Pertaining to Vehicles.

VEHICLE TIRE.—E. TALLMAN, Morley, Iowa. The invention provides a resilient tire constructed of spring metal to avoid disadvantages in the employment of rubber tubes of usual construction; provides a tire constructed from a series of sectional forms each detachable and replaceable; provides an articulated tire of metallic sectional springs, each co-operatively connected with adjacent springs to unify the action of the springs; provides a tire with stop members to reinforce the tire structure to avoid the breakage of single sectional springs when subjected to sudden strains; and provides for a tire a wearing shoe constructed from a series of assembled short removable sections.

Designs.

DESIGN FOR CARPET OR RUG.—J. S. BROWN, care of G. S. Squire, Hartford Carpet Corp., 41 Union Square, New York, N. Y. This design for a carpet or rug is oblong in form and exquisitely ornamental in composition. Inside and near the edge there is an elaborate border of figures in a white ground and a mass of small dotted circles separates this border from a bright centerpiece in a white field. Mr. Brown has patterned another carpet or rug design of the same shape, with a rather dark and brilliant mixed border separated from the centerpiece by a scrolled work runner in a white field. The centerpiece is elaborate and abounding in arrangements of flowers.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Retrospect of the Year 1911

(Concluded from page 591.)

plane. On January 30th, McCurdy attempted to fly from Key West to Havana. After covering ninety miles out of the one hundred in two hours, he fell in the sea, owing to a burned-out bearing on his motor. Mr. Glenn Curtiss first succeeded in rising from the water, with his biplane equipped with floats, at San Diego, on January 26th. Thus was born America's first hydro-aeroplane. Curtiss constructed a number of these machines, several of which have been supplied to our navy and one to that of Russia, which is very active in aviation. Using one of them, Hugh Robinson flew several hundred miles down the Mississippi from Minneapolis, carrying mail, which he left at the towns *en route*. The mail-carrying experiments made on a larger scale at the aviation meet at Nassau Boulevard, together with Robinson's demonstration, convinced Postmaster-General Hitchcock that the aeroplane can be used successfully for delivering mail to inaccessible places. Many exhibition flights have been made in America this year, the most daring and thrilling of all having been Lincoln Beachy's dip over Niagara Falls and flight through the gorge, which he made with a "headless" Curtiss biplane.

The chief development in aviation this year has been the change from the exhibition flight to the long-distance, cross-country race or tour. A half dozen big races, such as the Paris-Madrid, Paris-Rome, European Circuit, Circuit of Britain, etc., were flown successfully abroad and were practically all won by monoplanes, which appeared to be faster and safer than the biplanes. In America, however, Beachy and Ely gave some marvelous exhibitions of flying in strong winds with the latter type of machine. A Maurice Farman biplane, on March 7th, made the 225-mile flight from Paris to the Puy-de-Dome Mountain, without a stop, and carrying two men. Eugene Reneaux, the pilot, thus won the Michelin $20,000 prize which had been offered exactly three years before. Vedrines, on a Morane monoplane, won the Paris-Madrid race and secured second place in the 1,060-mile Circuit of Britain. This English event, as well as the Paris-Rome and the European circuit, was won by Lieut. Conneau, of the French navy, while Roland Garros was second in the two latter races. Both of these aviators used Blériot monoplanes. The Paris-Madrid race of 900 miles was covered in four days, and the Circuit of Britain required but three days' flying by Conneau and Vedrines. The two other machines which finished required thirteen and fourteen days respectively. M. Garros, on September 4th, made a new height record of 4,252 meters (13,950 feet), thus beating by 2,370 feet the record of Beachy at Chicago, and climbing some 750 feet more than 2½ miles above the earth's surface.

Last summer, Harry N. Atwood flew from Boston to Washington with his Wright biplane, carrying a passenger most of the way. Later, he flew from St. Louis to New York, by way of Chicago, in fourteen days. Enthusiastic over his success, Calbraith P. Rodgers and Robert G. Fowler started to fly across the continent from New York and San Francisco respectively. Both aviators used Wright biplanes, and were accompanied by special trains, carrying spare parts. After three unsuccessful attempts at climbing over the Sierra Nevada Mountains, Fowler finally flew by the southern route, which was the one chosen by Rodgers. Rodgers left Sheepshead Bay on September 17th. His route was *via* Chicago, St. Louis, San Antonio, and El Paso, Texas, from which State he followed the Southern Pacific Railroad. He finally reached Pasadena on November 5th. In flying the 25 miles from there to the Pacific Ocean, he sustained a bad fall and was laid up several weeks. Finally, on December 10th, he finished the first trans-continental aeroplane flight. He passed Fowler at Tucson, Ariz., and the latter has now progressed almost as far as New Orleans.

Orville Wright conducted some experiments with a 145-pound glider at Kitty Hawk, N. C., late in October. These experiments were of great interest from the fact that Mr. Wright succeeded in rising in the teeth of a 50-mile gale and remaining aloft once for 7¼ minutes, and again for 9¾ minutes. In the shorter flight, he hovered for five minutes above a given spot. Mr. Wright obtained valuable information relative to the designing of a machine with flattened surfaces, capable of flying in the strongest winds.

To the death list of flyers, numbering this year 76 should be added the loss of Octave Chanute, who was known as America's "Father of Aviation," and also that other pioneer, Prof. John J. Montgomery, of Santa Clara College, Cal. The latter was killed while experimenting with a new glider. A large number of the fatal accidents were due to recklessness and foolhardiness in making exhibition flights; but there have also been accidents from breakages of machines. The causes of the various accidents have not all been determined, but the proportion of deaths to the number of miles flown is without doubt less than in 1910. The carrying of as many as six passengers on cross-country flights of one hour, and the development of an aerial taxicab, which has flown successfully, has put heart into those who believe the aeroplane has a future as a means of public rapid transit. It will also undoubtedly be used for the regular carrying of mail in the near future. The severe tests for French military aeroplanes resulted in seven machines making a flight of 186 miles without a stop, when carrying two men and 660 pounds of dead weight. The winner was a Nieuport monoplane, piloted by Weymann, the American aviator, who also won the International Cup race for this country with the same make of machine on July 1st last. He made an average speed of 72 miles an hour in the military contest, with a 70-horse-power monoplane, whereas, in the International race, he made 78.1 miles with a 100-horse-power motor.

The development of the dirigible balloon has resulted, in Germany, in a passenger-carrying rigid airship, the "Schwaben," which has made numerous sight-seeing trips about the Fatherland, running, on schedule, with a regularity which has strengthened the belief in the commercial and military future of the dirigible. The "Schwaben" developed a speed of practically 43 miles an hour, with 450 horse-power, when accurately tested over a measured course. In France, the non-rigid dirigible has been developed to a point of gratifying efficiency, and the government is building additional Lebaudys for the use of the army. For scouting, the aeroplane is simpler and, in many ways, superior to the clumsy airship. At Tripoli recently, Italian aeroplanes are reported to have dropped bombs upon the Turkish troops, with disastrous effect. The huge English dirigible, the "Mayfly," broke in two when being drawn out of its shed, and as a consequence opinion in Great Britain is more favorable to the aeroplane. Two airships, the "Suchard" and the "Akron," were constructed this year in Germany and America for the purpose of crossing the Atlantic. The former is to start from the island of Teneriffe, and the latter from Atlantic City. Neither was completed in time to attempt a flight this year; but it is probable that next spring both will start in this great attempt. Mr. Vaniman, after his experience with the "America" in 1910, has constructed a new and larger airship, from which he believes he has eliminated the troubles which led to his previous failure.

A Dark Substance in Space

IN the vicinity of the star S Coronæ Australis Innes and Worsell have found a patch of sky 25 minutes of arc in diameter where no star can be seen with a 9-inch refracting telescope. According to Innes, who discusses the subject in "Transvaal Observatory Circular No. 5," the apparent absence of stars in this region is due to the occurrence of some absorbing medium, interposed between us and distant parts of the universe. Stars in the neighborhood of the dark region are enveloped in nebulæ; while just on the border of it there is a star which has been observed to fluctuate in magnitude between 11.0 and 12.2, and which was invisible during the years 1899-1901. The latter fact is accounted for on the supposition that the absorbing medium was for a time in front of the star, but has since withdrawn from it.

The Most Remarkable Testing Laboratory in the World

(Concluded from page 595.)

to decide whether or not a certain lubricant had spoiled a suit of clothes. The judge washed his hands of the matter and submitted the lubricant to the Royal Laboratory for Testing Materials. With characteristic thoroughness the Laboratory experimented with stains which were produced by the lubricant. First, it determined whether the stains could be eradicated by washing or only with the aid of special solvents, or not at all. Then it determined whether the color of the cloth had suffered as the result of attempting to remove the stains. Finally, it ascertained whether the strength of the cloth fiber had been impaired by the process of cleaning. It reported to the court that stains made with the lubricant on cotton, wool and linen could be easily removed; that the lubricant had no injurious effect on the dyes employed, and that the lubricant did not weaken the fiber, even after prolonged intimate contact—in a word, that the cloth was not irretrievably spoiled.

Settling Patent Infringement Suits.

In patent infringement suits, as might be expected, the Laboratory does yeoman service for the court. It does not construe claims, for that is a matter of law; but it determines matters of technical fact, with the result that a judge is spared the necessity of considering a mass of testimony which, to a layman in science, even though he be a lawyer, must seem a hopeless jumble of cryptic phrases. One such case turned upon the point whether or not a certain brand of soap was so greatly superior to another in washing qualities as to be patentably different. On behalf of the court, the Laboratory made a study of the two soaps to determine their solubility in water, acids and lime solutions, and their effect on dyes and on fabrics. It showed conclusively that the one soap was no better than the other.

These opinions of the Laboratory on matters of technical fact are by law made binding upon the courts. A judge must accept the technical decision of the Laboratory and rule accordingly.

Germany has a tariff, which, like our own, is intended to protect the home producer. Disputes with the customs authorities are therefore as frequent in Germany as in the United States. The American appraiser submits imported goods for scientific examination either to chemists or physicists in the employ of the customs service, or else he employs outside experts. The German customs authorities call upon the Royal Laboratory for Testing Materials for assistance. In a controversy which arose between the customs authorities and an importer of mercerized cotton, the government maintained that the fabric was dyed and therefore subject to a higher duty than if it were undyed. The importer insisted that the cotton was undyed. Gross Lichterfelde examined the fabric scientifically and supported him in his contention.

An American Appeals for Scientific Help.

Foreigners, too, resort occasionally to the Laboratory when the questions at issue affect German industry. I was told of an American importer of German paper who had been compelled, as he thought, to pay a higher duty in the United States than the Dingley tariff required. Because the importation was an oily German paper substitute for parchment, he asked the Laboratory to tell him how treated papers could be scientifically distinguished from untreated papers. He received an exhaustive description of the turpentine oil test, armed with which he intended to appeal to the American customs authorities again. Another foreign firm wished to ascertain whether its steel hydrogen flasks met the requirements of the German police regulations governing the traffic in liquid and compressed gases. Flasks were sent to Gross Lichterfelde. There it was found that the wrong kind of metal had been employed, and that the police requirements had by no means been fulfilled.

Whenever any department of the German Imperial Government is confronted with a technical problem for solution it is

(Concluded on page 604.)

PATENTS

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PATENTS

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PATENTS FOR SALE.

BROAD "BASIC," patent No. 1,011,574, Electric Heated Glove for drivers of all vehicles. The demand is tremendous and will require a comparatively small amount of capital to develop. A. L. Carron, Geneva, N. Y.

REAL ESTATE.

TEXAS INVESTMENTS.—Buy farm orchard garden lands near Houston, the greatest and most prosperous city in the southwest, where values are going up all the time and fortunes made in real estate in short while. Easy terms if desired. Single crop pays for land; several crops annually. Address E. C. Robertson, 501 Kiam Bldg., Houston, Tex.

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MISCELLANEOUS.

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INQUIRY COLUMN

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry may be repeated. MUNN & CO., Inc.

Inquiry No. 9254.—Wanted, the name and address of manufacturers of lead pencils and pen holders, such as are used for printing advertisements on.

Inquiry No. 9255.—Wanted, to buy a patent roller, a ball-bearing axle, which could be purchased on a royalty basis; it must be cheap and fully proved.

Inquiry No. 9256. Wanted addresses of parties having Pitchblende deposits, if able to ship ore.

Inquiry No. 9257. Wanted addresses of firms selling second-hand water turbines.

Inquiry No. 9258.—Wanted addresses of parties having gem materials to offer in any part of the world.

Inquiry No. 9259.—Wanted to buy a machine for removing the coating of a filbert.

Inquiry No. 9260.—Want addresses of parties able to ship corundum, garnet, flint, emery or any material suitable as anabrasive.

Inquiry No. 9261.—Wanted, a manufacturer to make card games.

Inquiry No. 9262.—Wanted, to buy a glass which is a conductor of electricity, and the address of the makers of the same.

The SCIENTIFIC AMERICAN *for* 1912

Magazine Numbers for 1912

JANUARY 6—
Annual Motor Number
FEBRUARY 10—
Science in Agriculture
MARCH 16—
Good Roads
APRIL 13—
Science in the Ideal Home
MAY 18—
Our Coast Defenses
JUNE 15—
Cause and Cure of Factory Waste
JULY 13—
Sanitation
AUGUST 17—
Chemistry in the Arts
SEPTEMBER 14—
Aviation
OCTOBER 12—
Labor-Saving Machinery
NOVEMBER 9—
Invention
DECEMBER 7—
The Panama Canal

AT the close of last year, under the caption of The Greater "Scientific American," the publishers announced that the scope of the paper would be extended; that a series of mid-month numbers of greatly enlarged size, contained in a colored cover, would be issued, the contents being devoted to some special subject of national importance. We also announced that there would be a series of articles written by specialists in their several departments, and that these new features would be accompanied by a general improvement in the typography and make-up of the paper.

¶ The fifty-two issues of the past year speak for themselves; and their favorable reception by our subscribers and the general reading public encourages the publishers to continue the same policy, on even more progressive lines, throughout the year 1912.

Special Contributors

THE high quality of the Scientific American of 1911 will be evident from a study of its list of contributors, conspicuous among whom were President Taft, Secretary G. v. L. Meyer, Admiral A. T. Mahan, the chiefs of the various bureaus, and other high ranking officers of the navy; Secretary Charles Nagel, of the Bureau of Commerce and Labor; The Hon. John Barrett, Director of the Pan-American Union; Commissioner of Navigation E. T. Chamberlain, ex-Chief Forester Gifford Pinchot; Director F. H. Newell of the Reclamation Service; Judge Judson C. Clements, Chairman of the Interstate Commerce Commission; Dr. J. A. Holmes, Director of the Bureau of Mines; Professor Ira Remsen, President of Johns Hopkins University; W. J. Spillman, and other members of the staff of the Department of Agriculture; Robert Kennedy Duncan, S. A. Mitchell, H. N. Russell, H. W. Walker, Moyer S. Fleisher, E. L. Thorndike, T. C. Martin, and W. C. Brown, President of the New York Central Railway Company.

The list of contributors for 1912 will be equally distinguished. It will include the majority of the names above mentioned, together with others of high authority in the various fields that will be covered during the year. The Scientific American will combine to follow closely its avowed policy, as stated at the head of its Editorial Columns: "The purpose of this Journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement."

The Broad Scope of the Paper

THE subjects dealt with in 1912 will come under the heads of civil, mechanical and electrical engineering; naval and military; the merchant marine; the internal combustion motor; chemistry with special attention to electro-chemistry and electro-metallurgy; science as applied to the industries; science in agriculture. There will be the usual amount of space devoted to biography, astronomy, scientific abstracts from current periodicals and archaeology. Under the subject of inventions, particular attention will be given to the leading inventions and to patent practice, with a reference to notable cases, and there will be the usual run of inventors' notes. The popular "Workshop" and "Laboratory" departments will make their regular appearance.

The Panama Canal Number

THE great popularity of our recent Naval Number, which was immediately recognized as a brochure on the navy of unusual authority and information, has decided the publishers to prepare a similar number in December, 1912, on the Panama Canal. The material for this issue will be gathered by our Editor-in-Chief, Mr. J. Bernard Walker, who will spend some time at Panama for the purpose of making a personal inspection of this stupendous work, and securing the necessary plans, photographs and data. The number will contain a complete account of the history, construction, operation, military defenses, and commercial and naval value to the United States of this great national undertaking.

Science in the Industries

AN important feature of the 1912 program will be a series of articles by Mr. Waldemar Kaempffert, Managing Editor of the Scientific American, in which he will sketch the scientific basis of Germany's remarkable commercial success—the object of this series being to offer for the consideration of the American business man certain well-proved methods for increasing the physical efficiency of the workman and the amount and quality of his output. Two of the articles will deal with German education—"The German Commercial High School", which turns out captains of industry, and "The German Vocational School", which turns out soldiers of industry. The series will also include the following articles on the relation of science to industry: "The Royal Laboratory for Testing Materials at Gross Lichterfelde" (published in this issue); "The Utilization of Waste Materials"; "The German Technological Museum at Munich" (the remarkable technological museum in which the visitor is allowed to manipulate, through a crank or other means, an operative apparatus); "The Workingman as a Human Machine"; "The State and the German Laborer"; "City Government as a Science"; and lastly, "The Commercial Utilization of Scientific Discoveries"—a summing up of impressions gleaned from a dozen factories, workshops and cities. These articles will be based upon the facts and impressions gathered by the author during a recent extensive tour of Germany, made for this express purpose.

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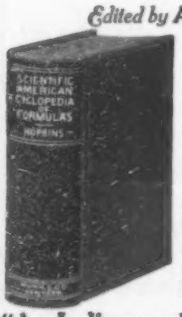

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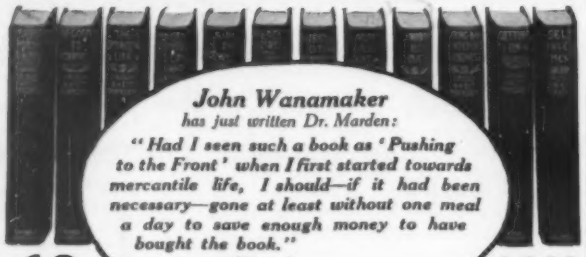
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almost sure to ask Gross Lichterfelde for advice. Thus, for the Royal Powder Works of Spandau, specifications were formulated for the manufacture of machine and cylinder oil, machine greases, linseed oil, turpentine oil and vegetable oils. For the Minister of Public Works a scientific test for distinguishing natural from artificial asphalt was worked out, and a study made of the thermal conductivity of refractory building materials. When the Imperial Printing Office decided to improve the quality of German post cards, Gross Lichterfelde made a study of existing cardboards and papers and practically invented a new composition which would answer modern commercial requirements. Hand in hand with the Artillery Testing Commission, tests were made with copper cylinders for measuring gas pressures. Even the German colonies consult the Laboratory, for the German governor in Togo and Kamerun submitted African woods for comparison with North and South American woods, with the result that in the near future Germany will probably draw upon her African supplies.

The institution at Gross Lichterfelde has a history that extends back to the experiments made by Dr. A. Woehler, an engineer who, in 1863, constructed the first really scientific testing apparatus employed in Germany. But the remarkable place which the institution has won in German industrial life and its world-wide reputation is due almost entirely to its present head, Geheimer Oberregierungsrat, Prof. A. Maertens. When he was appointed to fill the director's chair in 1884 the entire scientific staff of the mechanical-technical department consisted of only three men, and the apparatus of two testing machines. What the development of the Laboratory has been since then may be judged from the highly varied character of the work here outlined. That astonishing development would hardly have been possible had not Maartens himself devised a very large part of the experimental apparatus which constitutes the equipment of the Koenigliches Material-Pruefungsamt.

Methods of Dust Extraction on Cotton-carding Engines

(Concluded from page 593.)

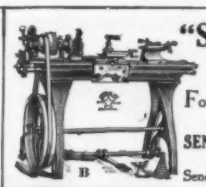
air trunk; this aperture is closed when stripping is not in operation at that machine. The draught is thus concentrated on one machine only. The aperture is automatically opened by the receiver itself as it reaches the machine to be stripped. The appliance is propelled by hand to any part desired by the workman. On arriving at a given machine, the funnel-receiver is brought immediately over the card-cylinder, close by the line where the dust is generated by the stripping-brush, and the indraught collects the dust before it can diffuse.

By a third method (Fig. 5) of dust extraction a vertical tube is provided over each carding-engine, this tube being connected with a casing or "hood," which is lowered to cover the stripping-brush when operating. A sliding shutter is fitted in the vertical tube. This is opened when ready for stripping, all other shutters being then closed. Thus the exhaust from the fan is concentrated on one "card" only. When stripping is completed the hood is raised in the vertical tube.

A fourth method (Fig. 6) has pipes depending from horizontal trunks following the lines of cards; but in each pipe is a patent valve, formed where the pipe can be flexed. When the pipe is vertical the interior is fully open; when flexed as far as possible, the aperture is closed. Hence in all tubes bent, so as to be out of the way of the workers, the valves are automatically closed. To operate this dust-extractor an aluminium cover is provided for each stripping-brush. The outlet pipe of the cover fits into the downpipe just mentioned, so that when the fan is started the dust is drawn off as stripping proceeds. The power required for an average mill is estimated at about one horse-power.

The method now described (Fig. 7) works on a portable principle. The stripping-brush is inclosed in a hood which has a flexible-tube connection with the dust-extractor. This comprises a portable chamber built on an angle-iron frame, braced with tie-rods and bolts, and having a wooden top and base. The

(Concluded on page 607.)



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whole is moved on wheels after the style of a bogie, and contains the exhaust fan and dust-bag. When stripping, the fan is operated by bands running from the carding-machine to grooved pulleys on the ends of the fan-shaft, these pulleys availing for right- or left-hand cards. The stripping of a card having been completed, the brush and casing are placed in brackets on the top of the chamber, and the next card is similarly treated.

Most of these dust-extractors perform another important function. They may be used as ventilators of rooms generally, apart from the removal of dust from carding-engines. The stripping process is performed four times each day, and occupies 40 to 60 minutes. In the intervals between these operations any of the apertures of the dust-extractors, may be opened in any part of the room. Impure air may thus be drawn from twenty or more localities at the same moment by moderate exhaust currents, and without draughts playing on the workers. The improved condition of the air from the use of these widely-distributed exits will be readily appreciated.

With the installation of dust-extractors in the card-rooms of cotton mills, the health and working efficiency of the operatives concerned will be considerably improved. Likewise the material produced, in the shape of finished yarn, being free from specks of dust, will be very materially enhanced in its market value.

Telephones in Great Britain

ON December 31st, 1911, the telephone service of the United Kingdom will become, like the telegraph service of that country, a government monopoly.

The history of British telephones is reviewed in a recent report of Consul Rufus Fleming, stationed at Edinburgh. An act of 1869 gave to the Postmaster General the monopoly of operating telegraphs, and in 1880, as a result of the case of the Attorney General vs. the Edison Telephone Company, it was decided that telephones were included in the provisions of this act. However, the government, instead of buying up the patents and taking the telephone service into its own hands, granted licenses to the existing telephone companies. At first the companies were restricted in their operations to limited areas, but from 1884 onward the licenses were applicable over the entire kingdom. This led to the organization of large companies, and by 1892 practically all the business was in the hands of the National Telephone Company, Ltd. In 1896 the government took over the operation of all the trunk lines connecting one town with another, paying the company upwards of $2,233,723. The latter has since continued to operate the local lines, but will transfer all its business to the postoffice at the end of the present year.

There are approximately 644,000 telephones in the United Kingdom, but it is estimated that if the system were used in the same ratio to population as in the United States, the number would be nearly 3,000,000. Judging from the history of the telegraph service, it is expected that the transfer of the telephones to the government will result in a great extension of the system.

A Fiber Exposition in Java

A UNIQUE exhibit of fiber plants and fiber-working machinery has been held at Soerabaya, Java, during the past summer, in connection with the Fiber Congress of the East Indies, which opened July 3rd. Dutch, German, and British machinery was represented, made by Krupp, Benisch, Berand Liebescher, Lees & Co., and Oldham. All the fiber plants of Java, and many from the Philippines, Siam, etc., including sisal, agil, pineapple fiber, banana fiber, coconut fiber, Java cotton, kapok, and others, were exhibited. One exhibit showed the natives of Java working kapok and cotton from the very first stage of preparing the fiber to the finishing of the woven cloth.

Kapok is the silky fiber surrounding the seeds of the silk-cotton tree (*Ceiba pentandra*), one of the noblest trees of the tropics. It is extensively used in stuffing mattresses, and also in filling life-preservers, for which latter use it is especially valuable, as it will support a greater weight in water than any other substance used for this purpose. A mass of pressed kapok will support thirty-six or thirty-seven times its weight.

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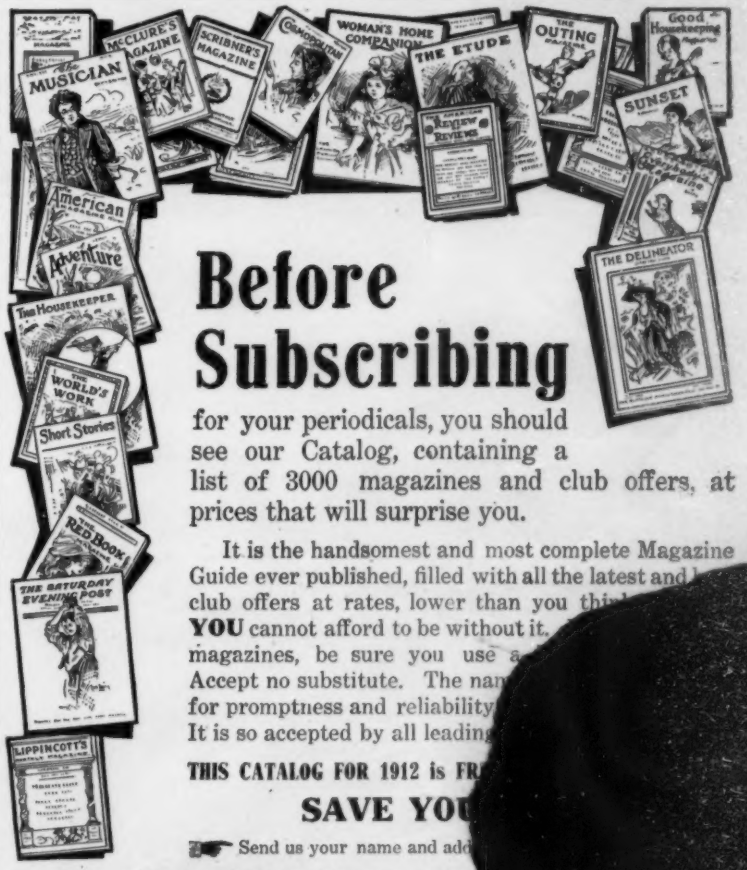

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The Methods of Dust Extraction on Cotton-carding Engines

Safeguarding the Workingman's Health

By J. H. Crabtree

THE efficiency of cotton mills is intimately dependent upon the working conditions prevailing therein. Fresh, dustless atmosphere at a reasonable temperature is of paramount importance in promoting the welfare of the workers during their daily occupation.

How to clear the air in certain parts of these mills has for some time occupied the serious attention of employers. Several schemes, more or less effective, have been launched forth; but few have gone beyond the experimental stage. They are either too expensive, or impracticable on a large scale.

The common plan, until recently, was to install fans brush. The wires thus cleanse the cotton, combing and preparing it for the "frames" which follow.

As each carding-machine has two cylinders, one of which is 4 feet wide and makes 160 revolutions per minute, it follows that in a few hours the wires become surcharged with dust and short fibers. And if they were not stripped of these they would be so glutted with refuse that the machine would fail to do its work. Hence, when the carding-engine has been in operation for two or three hours the process is stopped, and the two strippers bring up a cylindrical brush covered with wire bristles. This is placed in contact with each of the cylinders in turn, and revolved at a rapid rate.

The brush strips the wires of nearly all the short fibers which clogged up the interstices. It also roots out the dust and sticks which have been retained in the cotton up to its treatment in the carding-machine. When the stripping-brush has done its work, it is an easy matter to clean it by means of a hand-card. It contains short fibers only; the dust has passed into the air of the room in dense volumes.

Here, then, is the specific function of the new appliances—to prevent this dust pervading the air of the room. This is of greatest importance to the men who manipulate the brush. They must stand in close proximity while the brush is revolving. The volumes of dust pass into their nostrils, and much is unavoidably inhaled. This involves serious risk to the men, and in time, tells upon their physical strength. It is, indeed, seldom that strippers are able to follow their employment to a normal age of say 60 to 65 years. The work induces pulmonary troubles in some men at an early age.

The danger is, to some extent, mitigated where the men adopt the precaution of holding a tuft of clean cotton fiber, pressing it between the lips while stripping. This forms an old-fashioned respirator (Fig. 1), which is used daily by men who have often proved its value. Other men have recourse to specially-designed respirators, which are adapted to facial outline (Fig. 3), and preserve the mouth and nose from contact with dust. The fact that strippers have suffered acutely from their occupation has been definitely proved by investigations in various cotton towns where between 40 and 50 per cent have been found affected in varying degrees.

Fans, exhaust or indraught, have doubtless done much to purify the air of carding-rooms; but they do not touch dust-clouds for some time after the dust is generated. The result is that the dust becomes mixed with the air of the room and, after having affected the strippers close by, it is diffused in the room generally, and traverses the area where the women and girls are at work on the spinning-frames. There is a moderate amount of dusty material given off from the frames themselves in cotton mills. This in itself, however, does not occasion either inconvenience or injury. The new methods work on different lines from any before put into practice. Several of these are now in operation, but the general principle adopted is to collect the dust at the point of its generation and remove it by means of trunks to the external parts of the mill-premises or to inclosed dust-chambers.

Fig. 1. Simple and primitive respirator. A tuft of cotton held between the lips.

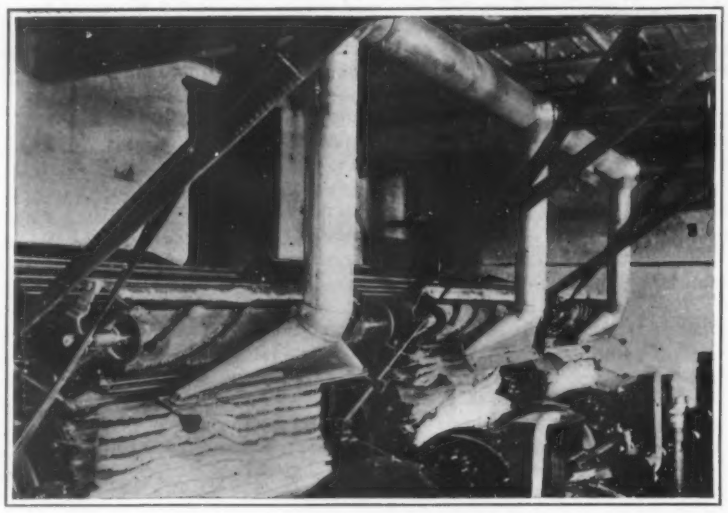


Fig. 2.—Fixed dust extractors in series.

Fig. 3.—Respirator specially designed for use by cotton-mill workers.

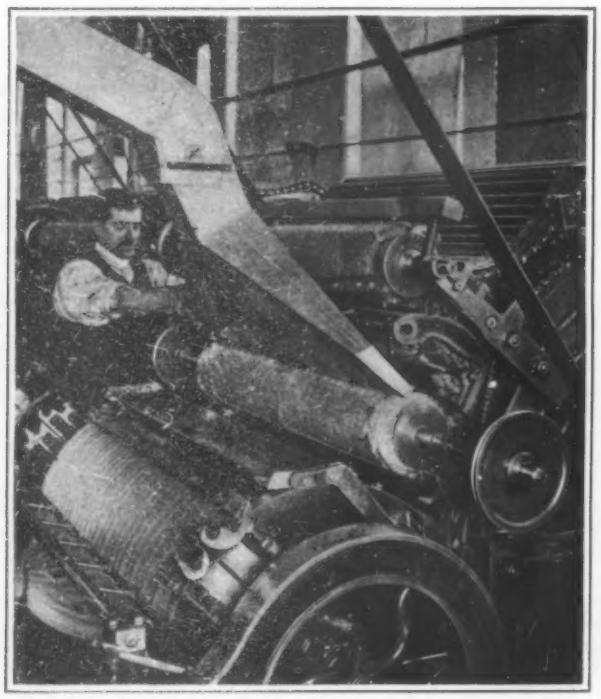


Fig. 4.—"Traveling extractor," with stripping brush over the main cylinder of the carding machine.

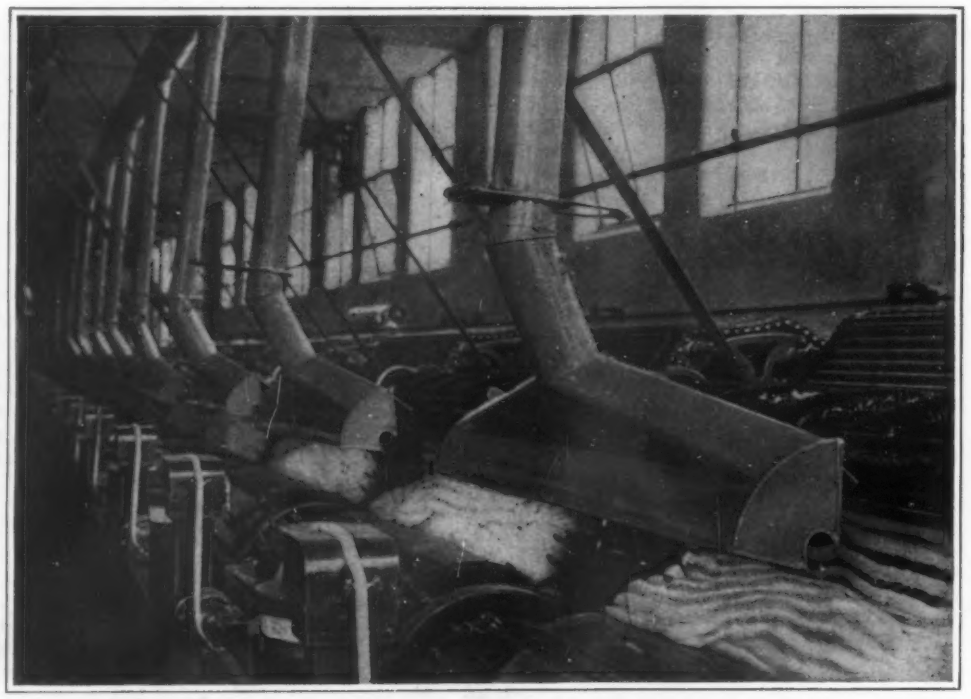


Fig. 5.—Another form of fixed "dust extractors" in series. When stripping is completed the hood is raised in the vertical tube.

THE METHODS OF DUST EXTRACTION ON COTTON-CARDING ENGINES

of 15 to 24-inch diameter in wall-boxes or window-frames, at various parts of the room, and exhaust the impure or dusty air so as to change the atmosphere of the room three or four times during each day. Dust is generated in most carding-rooms in such a degree as to be particularly injurious to the strippers. In card-rooms the raw cotton is combed, in machines known as "carding-engines," by a myriad of pointed wires attached to revolving cylinders.

A roll or "lap" of cotton is fixed on the front of this machine, and it issues from the back as a thick woolly band of yarn, with the fibers combed in one direction.

This machine makes the first semblance of a thread in the operations of a cotton mill. Between the lap and the thick yarn the cotton is passed over the cylinders covered with wires. Here the short fibers are held between the wires; the dust and small particles of the cotton-plant are also retained here. These millions of wire-points act much like an ordinary clothes

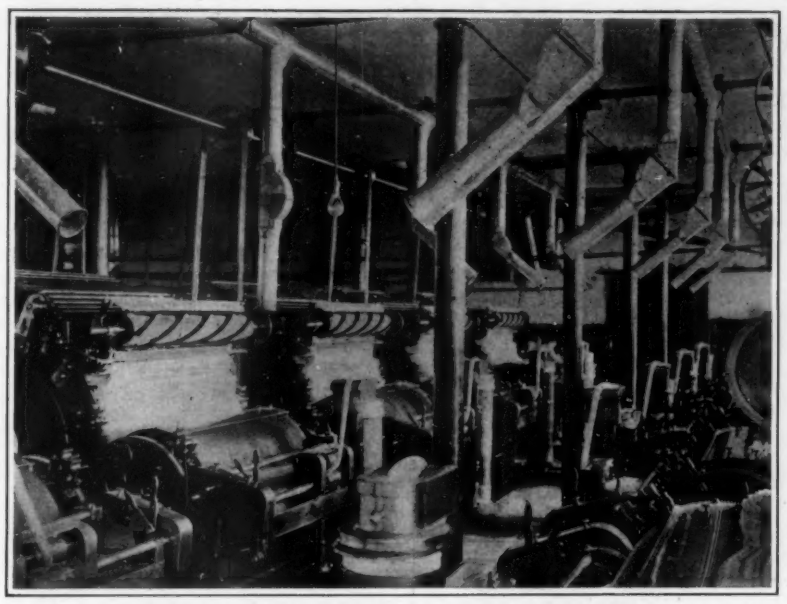


Fig. 6.—"Dust extractors" with automatic valves.

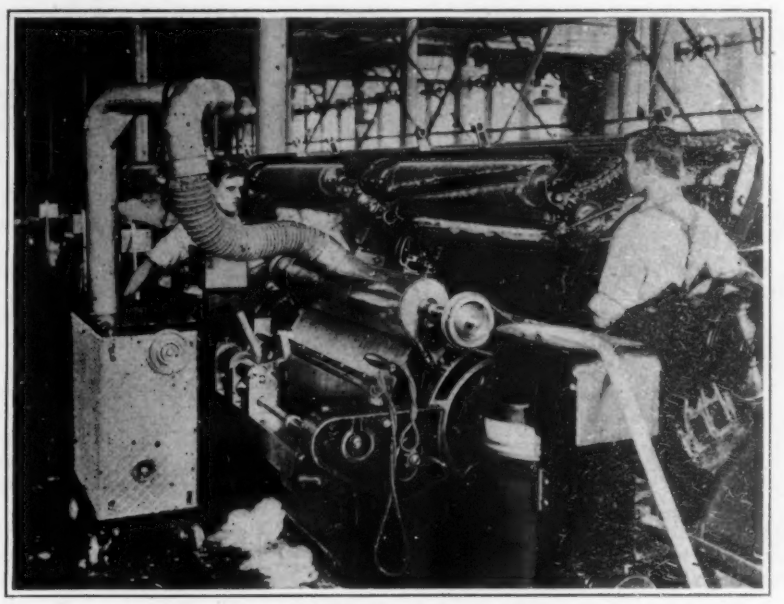


Fig. 7.—"Portable dust extractor."

THE METHODS OF DUST EXTRACTION ON COTTON-CARDING ENGINES

Several plans are at work in the cotton districts of Lancashire. By one of these (Fig. 2) a dust-receiver is fixed over each carding-machine. This is as wide as the machine itself and has an opening about 2 inches wide; it bears a balanced lid by which the aperture can be opened and closed at the will of the stripper. The receiver is attached above to a carrier-tube running to the main air-trunk. In this an inclosed blower runs at 1,200 to 1,500 revolutions per minute. The blower will take care of forty to sixty carding-machines, and the additional mechanical power used is nominal.

The *modus operandi* is as follows: When the strippers place the revolving brush on a carding-machine, the receiver-lids of the whole series are closed except the one over this particular machine. Thus the total exhausting force of the blower is concentrated on one machine; and when the stripping begins, the air-currents about the aperture are strong enough to gather the dust as it is generated. The attendants require no cotton tufts or respirators; the dust is completely prevented from reaching their breathing organs.

Then the receiver-lid is closed, the brush removed to the next machine, another lid opened, and the process is repeated throughout the series of fifty or sixty machines.

Another method (Fig. 4) has been devised, in which a single traveling receiver is available for each row of carding-machines. In cotton mills generally these machines are laid in parallel lines of ten to forty, with intervening spaces of 10 to 18 inches. It is therefore possible to build up carrier-tubes in line with the machines, and about four feet above them. On either side of the tube-line a rail is fixed to hold the grooved wheels of the traveling receiver.

The exhaust in this arrangement is maintained by a blower running at about 1,300 revolutions per minute. Over each carding-engine is an aperture in the

(Continued on page 604.)

New Tide-predicting Machine

By M. H. Talbott

UNCLE SAM'S new tide prophet is a machine which outclasses all human competitors; it is capable of doing in one day work which formerly required the services of sixty-five computers. It was invented by Mr. E. G. Fisher, of the United States Coast and Geodetic Survey, and is used to predict the height of the water at any instant on any date from one to two years in the future for every port in the United States and seventy of the principal ports of the world. This information is issued in the form of a book by the Coast and Geodetic Survey.

Tide predictions are based on local as well as astronomical conditions that influence the rise and fall of the ocean. At every port in the world there is an instrument which indicates these fluctuations by a curved line on a sheet of paper, and from a long series of such observed curves computers have evolved the average of each component at each place. The formula upon which this perfected machine is based includes thirty-seven of these components. There are a set of gears to represent the sun's influence, another to take the place of the moon, various other sets which act for the planetary movements, and still other sets which speak for local conditions.

The machine looks like a huge printing press. A skeleton frame of brass, steel, and iron occupies a space 11 feet long, 6 feet high, and 2 feet wide, and from the dial indicators in the front to the opposite end it is a maze of wheels, gears, pulleys, and chains.

There are three hundred gear wheels and pulleys in the machine. These are arranged in two main sections, one representing the time, the other the height of tide. Two chains, each permanently fastened at one end, run through each section, and their free ends are attached to indicating devices.

The operator beginning a set of predictions adjusts the eccentrics connected with each set of gears. By turning a crank he causes the wheels to rise or descend, thus lengthening or shortening the free end of the chain. This variation appears on the dials at the front of the machine, one pointer showing the height of water in feet and tenths; the other the day, hour, and minute of the occurrence. An electrical device stops the machine whenever a high or low water is indicated.

While the operator is recording these figures, the machine is doing a still more detailed work. A strip of paper 6 inches wide and 380 feet long is moving automatically across the face of the machine, and while one pen is marking the hours and exact times of highest and lowest waters, another pen is tracing a curved line which shows the gradual rise and fall.

The information turned out by this machine is sought by the marine engineer who wishes to calculate for improvements, and the hydrographic surveyor who is laying plans for future surveys, as it enables him to know the depth and time of high and low water on any date a year or two in advance.

A MACHINE THAT FORETELLS THE TIDES.

Weighting of Silk

IT is much to be regretted that many unscrupulous manufacturers resort to weighting, or "loading," raw silk in the dyeing process, to such an extent as to render it a very uncertain and treacherous fabric, with a tendency to split and crack even when carefully folded and laid away. In this dyeing process the natural gum of the silkworm is first removed from the silk by a method of "stripping," as it is called, in order that the raw material may properly take and hold the dye. This causes a loss of weight which dyers have always sought to restore, but instead of being content with doing this, the thrown silk is dipped into a solution of bichloride of tin, nitrate of iron, or some other chemical compound, for the purpose of giving it more weight than that lost in the stripping process, so that a hundredweight of silk in the raw state is often made to weigh three, or even four, hundred pounds when the dyeing is completed. As raw silk is bought and sold by the pound, the gain to the manufacturer is obvious. This operation makes the silk more valuable, but destroys the durability of the filaments.

Stretching the threads by steaming, so that a given weight will weave a greater number of yards, and the addition of chemicals to give it an unnatural luster, are other processes that prove profitable to manufacturers, but costly to consumers.

It is a mistaken idea with many people that the heavy silks are the best and most durable. Just the reverse is true. The light weight, or "pure dye silks," as they are termed, are much stronger and more durable, as only enough added weight is given to this class of silks, in the dyeing, to replace the loss in the stripping process.

The use of inferior and destructive dyes is another method equally as common and equally as reprehensible, by which many manufacturers impose upon the consumers in the dyeing of silk.

Charles Edwin Bessey

The New President of the American Association for the Advancement of Science

By Marcus Benjamin, Ph.D.

AFTER an absence of eight years the American Association for the Advancement of Science returns to Washington for its annual meeting. In 1903 the presiding officer was the chemist, Ira Remsen, who still guides with consummate skill the fortunes of the Johns Hopkins University. At the present meeting a botanist, who for forty years has faithfully attended the gatherings of the Association, will preside over its proceedings.

Charles Edwin Bessey was born in Milton Township, Wayne County, Ohio, on May 21st, 1845. His ancestry on his father's side is of French origin; for the Besses, as the name was formerly written, were Huguenots who fled from their native country to England and then about the middle of the eighteenth century Jacob Bessey came to America, settling near Doylestown, in Pennsylvania. In 1832 his grandson Adnah moved with his parents to Wayne County, Ohio, where later he married Margaret Ellenberger, of German descent, and there the son was born.

Young Bessey received his earliest education in the public schools of Ohio, and after preparing for college in the academies in Seville and Canaan he entered the Michigan State Agricultural College in Lansing where he was graduated in 1869 with the degree of Bachelor of Science, and where three years later he received a Master's degree. His intention on entering college was to become an engineer but he was advised to specialize in botany, which advice he reluctantly accepted. After much reflection, on so informing the president, he was told: "Well, Bessey, I am glad of it, but you'll never be rich," and then a moment later, "Yes, I am glad of it, but you'll never be rich." After graduation he was able to study his chosen specialty at Harvard, where he was fortunate in coming under the influence of Asa Gray from whom he acquired the foundations of the knowledge of systematic botany, especially in its philosophical aspect.

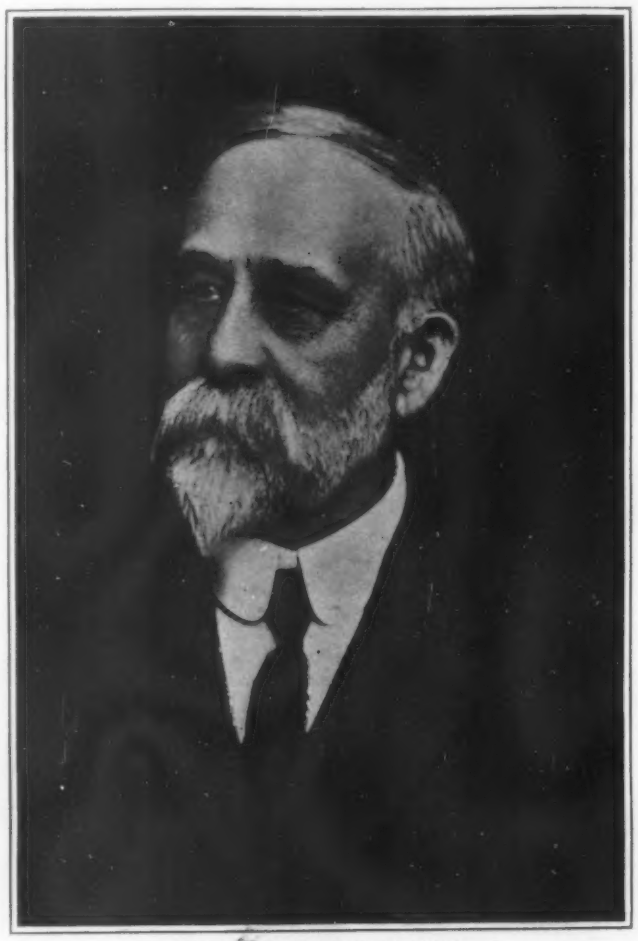
Preferment in those days was naturally in the direction of teaching and in 1870 he was called to the chair of botany in the University of Iowa where he continued for fifteen years, serving also as acting president during the year 1882. He accepted a call to a similar charge in the University of Nebraska in 1884, where he has since remained, being also head of the department. During 1885-1891 he was acting chancellor of the university, and again held this high office during 1899-1900 and during 1907-1908. He was dean of the Industrial College of the University of Nebraska during 1884-1888 and again since 1895; also during 1888-1891 he was dean of the College of Literature, Science and Arts of that university.

While botany has been his favorite study it has not been his only interest; for as he says: "In Iowa I began at once to write for the agricultural papers, telling people how to plant and what to plant; telling them about weeds and grasses; telling them also about insects and their bad habits; for entomology was one of my studies at that time." He joined the Iowa State Horticultural Society and read a paper on harmful insects, and took part in the first Farmers' Institutes held in Iowa during the winter of 1870-1871. On moving to Nebraska he was equally interested and at once began to collect information on the grasses of the State, reading a paper on the subject before the Farmers' Alliance; also presenting papers before such organizations as the Fine Stockbreeders' Association, Dairy Men's Association, Beekeepers' Association, State Agricultural Association, and the State Teachers' Association.

His literary activity has been very great; for besides many contributions to technical journals and papers read before scientific organizations he was for years botanical editor of the *American Naturalist* and has held a similar relation to *Science*. He was the editor of the botanical contributions, most of which he wrote himself, that appeared in the later editions of the New Universal Cyclopedia. Also he edited McNab's "Morphology, Physiology, and Classification of Plants" (1881). His principal works in book form are: Geography of Iowa (1876); Botany for High Schools and Colleges (1880); The Essentials of Botany (1884); Elementary Botanical Exercises (1892); Elementary Botany (1904); Plant Migration Studies (1905); and Synopsis of Plant Phyla (1907).

In honors, he has received elections to the Phi Beta Kappa and Sigma Xi societies, organizations in which membership is restricted to those who have done something. The degree of Ph.D. was conferred on him by the University of Iowa in 1878 and that of LL.D. from Iowa College in 1898. It may also be mentioned that he is a trustee of Doane College and he is a member of the Schoolmasters' Club.

Prof. Bessey is a member of many scientific and educational societies, as shown by the following list of organizations, in all of which he has been a prominent officer. He is a life member of the Botanical Society of America and was its president in 1896-1897; also he is a member of the National Educational Association, serving it as vice-president in 1896; and he is a member of the American Microscopical Society, of which he was president in 1902. His connection with the American Association for the Advancement of Science began with his election to membership at the Dubuque meeting in 1872. He was advanced to the grade of fellow in 1880, and has served the Section of Botany as chairman with the rank of vice-president, at the meetings held in 1890, 1902, and 1908. His long and valued connection with this foremost scientific organization in the United States gained for him the well deserved recognition of an election to its presidency at the meeting held in Minneapolis last December.



PROF. CHARLES E. BESSEY

President of the American Association for the Advancement of Science.

Opinions and Beliefs in Science

AS scientific experiments cannot be reproduced, authority necessarily remains our principal guide. In a remarkable book which bears the title "Opinions and Beliefs," the well-known French scientist Gustav Le Bon shows how large a part mere hearsay plays in scientific investigation. A scientist never publishes results which he does not suppose to be exact, but the influence of suggestion is so strong that even regarding very precise facts, an intelligent person may come under an illusion and take the visions of his imagination for realities. One of the most striking of this kind is the mischance to which nearly all of the members of the Academy of Sciences were victims about forty years ago. On the faith of an eminent mathematician, the assembly inserted in its proceedings about a hundred letters supposed to be written by Newton, Pascal, Galileo, and others. These had been made entirely by a forger of little education and were full of vulgarities and errors, but the names of their celebrated authors and of the scientist who presented them caused them to be accepted. Most of the members had no doubts about their authenticity up to the day when the forger avowed his fraud. When the prestige had vanished, the style of the letters was pronounced wretched by the same persons who before had praised them highly.

The recent adventure of the N-rays is even more typical, and brings out not only the rôle of prestige, but also of suggestion and mental contagion. Here we have to do not merely with experiments which are taken as faith by those who have no opportunity to verify them, but also with observations declared to be exact by a very large body of scientists who claimed to have repeated them. M. Blondlot, a leading professor of physics, observed, as he thought, that many bodies gave out special rays, which he called N-rays. These were detected mainly by their action on phosphorescence. Their wave-length could be measured very closely. What is most singular is that most of the French scientists working in this field repeated his experiments and saw exactly what was suggested to them to see. For two years the Academy proceedings were full of reports from scientists such as J. Becquerel, Broca, and Bichat on the wonderful properties of the rays, and Prof. D'Arsonval, among others, delivered lectures upon them. The French Academy wished to recompense such an important discovery, and delegated a committee headed by M. Mascart to make an official examination of the author's researches. The committee were much impressed, and thus a prize of $10,000 was awarded to the author.

During this time, however, foreign scientists who did not come under the prestige of the French savants, tried in vain to repeat the experiments. Then several of them decided to go to the author's laboratory to observe them. They soon found that he was the victim of a most complete illusion, for he would continue to make measurements of the supposed deflections of the rays, even when the "deflecting" was surreptitiously removed. The matter was carefully examined by a number of scientists, with the result that the specter of the N-rays was laid, once for all.

A few years ago an assistant in Prof. Lippmann's laboratory at Paris claimed to have discovered that an electrified body in movement did not deflect the magnetic needle (contrary to Rowland's experiment), a result which would have been of the highest importance for the theory of electricity. The author was not well known, but as the work was done in the presence of Prof. Lippmann, he had the benefit of his authority, and the question was discussed by physicists until a foreign scientist proved that the conclusions were erroneous and showed the reason why. In the case of the exact sciences the truth comes out sooner or later, as we have to do with real measurements and close observation. It is not the same, however, for sciences which are in a less developed stage, such as medicine; here it is very difficult to verify results, for we do not know what effects are to be attributed to suggestion or to the remedy itself, so that the errors persist for a much longer time. To enumerate them would be to go over all the history of medicine and show that theories, remedies and reasoning change every quarter of a century. About fifty years ago, the treatment of pneumonia by blood-letting was considered in France as one of the fine conquests of medical art, and its value appeared to be proved by statistics, which showed a mortality reduced to 30 per cent. Thus the remedy held its place until a doctor who visited a homœopathic hospital at London found that the mortality there did not exceed 5 per cent. This was a revelation. Instead of using diluted remedies, none at all were used, and soon the mortality in France fell to the same figure. To-day, instead of weakening the patient by blood-letting, he is strengthened by alcohol stimulants. This is a good example of the change in expert opinion. There is no need to multiply the examples, and it seems evident that the greater part of our scientific opinions should not be termed knowledge, but rather belief.

A Laboratory for Manufacturers

A German Scientific Institution That Tests a Manufacturer's Raw Material and Products and Gives Him Scientific Advice

By Waldemar Kaempffert

THIS is the first of a series of articles intended to show the part that science plays in German industry and commerce. The author of the article, Managing Editor of the SCIENTIFIC AMERICAN, *was sent to Europe by the publishers to study German industrial conditions with this object in view.*

A Saxon manufacturer of silk cravats found that his orders were steadily diminishing, although the season and the market were both in his favor. He made an investigation and discovered that his customers were buying silk cravats from a Prussian manufacturer at a price fifty per cent less than that at which he could produce them. To the Saxon's eye and touch the cheaper cravats were as good as his own. He could detect nothing in the material that could explain why cravats exactly the same in appearance should be sold at two widely different prices. He spent a month in thoroughly overhauling his factory. He found that he was buying his raw material at the lowest possible prices; that his wages were not higher than they should be; that his overhead charges were not excessive, and that his organization was good. Yet the fact remained that the Prussian was underselling him and was apparently making money.

The Saxon was an expert in cravats—at least he thought he knew all about them, because he had been making them for the better part of his career. Yet for the life of him he could not explain why it was impossible for him to compete with the Prussian. One day a salesman of his suggested that it might be well to have the Saxon and the Prussian cravats scientifically compared by the Koenigliches Material-Pruefungsamt—the Royal Laboratory for Testing Materials at Gross Lichterfelde, near Berlin. The examination would cost but little and might explain the mystery. As a manufacturer, the Saxon was convinced that he knew more about cravats than any scientist in any government testing laboratory, and that his trained eye and his sensitive thumb were more to be relied upon than lenses and chemicals. Still he consented. Samples of the Prussian and Saxon cravats were sent to Gross Lichterfelde. Two weeks later he received a formal report. His own cravats were pure silk. The Prussian's cravats were half genuine silk and half artificial silk (nitro cellulose). A chemist and a microscopist, neither of whom had ever made a cravat in his life, had not only discovered in an hour or two a deception that a manufacturing experience of thirty years had failed to note, but even revealed what particular process had been used in making the artificial silk employed.

The Technical Problems of Commerce.

It would not be difficult to relate a hundred instances such as this, all of them typical of the work done at the most remarkable testing laboratory in the world. At Gross Lichterfelde I saw not only cravats undergoing a rigorous scientific investigation, but chains, girders, paper, textiles, wood, dyes, copper, rubber, ink, typewriter ribbons—almost every kind of material that is used in our daily lives. Sometimes, as in the case of the Saxon manufacturer of cravats, the manufacturer was puzzled by a rival's success; sometimes he found himself with oxidized metal or faded goods on his hands, unable to discover the cause of the defects; sometimes he thought the customs officers had wrongly appraised his importations, because they had misjudged the character of the material; sometimes he wanted to know which of several raw materials should be employed for a specific purpose and was unable to decide himself.

The Royal Laboratory for Testing Materials works hand in hand with the German industrial. For a sum of money that must seem slight to Americans it places at his command a staff of two hundred and twenty-two men, seventy-two of whom are technically trained and the highest authorities in their respective departments of science. These men have at their disposal an equipment that includes the best obtainable apparatus for testing and analyzing any given material.

In Germany, indeed in Europe, the Laboratory is regarded as a court of last resort in matters involving the application of science to business. It is frequently difficult for a scientific man in the employ of a large corporation to deliver an absolutely impartial opinion on his firm's product. Inevitably there is a tendency to underestimate the products of a rival manufacturer and to view his own with favor. There is no such tendency in the Royal Testing Laboratory. Every chemist every engineer, every microscopist, every physicist, is a government official, and, as such, he is enabled to assume an absolutely impartial and judicial attitude toward the problem given him for solution. Indeed, impartiality is insisted upon, not only in the testing and examination of materials, but also in the phrasing of the reports submitted to an applicant for information. The manufacturer who can use one of the Royal Testing Laboratory's colorless opinions for advertising purposes would be miraculously ingenious. To restrain him, however, from exercising too freely what average ingenuity Nature has endowed him, and to prevent him from quoting with approval a report which is many years old and not at all applicable to his present goods, the Director of the Laboratory refuses to furnish certified copies of opinions more than one year old, and sometimes goes to the trouble of checking up advertisements in which reference is made to the favorable opinion of the Royal Testing Laboratory.

Scientists Who Study Factory Methods in Factories.

In order that the Laboratory may keep in close touch with industrial developments, members of its staff are sent from time to time to factories in order to study the exact manner in which textiles, cement, paper, ink, and the like are made. Thus, when it was decided to elaborate the equipment for testing caoutchouc and electric insulators, the exact manner in which rubber goods are made industrially was carefully studied, so that machinery could be designed which would enable a chemist or physicist to determine those facts which would be most useful to a rubber manufacturer. What manufacturer, for example, can tell definitely whether or not rubber goods should be stored in moist or dry rooms; whether that room may be indifferently hot or cold, dark or light; whether a rubber strip should be stored stretched or unstretched? These and similar questions Gross Lichterfelde will soon answer for him definitely, as the result of a long series of most practical experiments.

German manufacturers have not been slow to recognize the immense value of a government laboratory which solves for them the technical problems of commerce. A number of manufacturers of electric insulating materials jointly supplied the necessary funds for a painstaking study of insulating materials and of the insulating properties of rubber substitutes. The many compositions submitted were tested at various temperatures to determine their readiness of manipulation in the factory, their behavior under tension, torsion, and traction; their hardness; their ability to withstand exposure to weather and chemical corrosives. When the results of these studies are published, the Society of German Electro-Technicians will frame specifications for electric insulating materials, in which for the first time some admirable substitutes for rubber will receive their due.

How very impartial is the attitude assumed by the Laboratory is apparent when it is considered that manufacturers of competing materials may appeal for scientific information to Gross Lichterfelde at the same time. Sand-lime brick and clay brick are competitive building materials. Yet a powerful association of sand-lime brick manufacturers and an equally powerful association of clay brick manufacturers simultaneously consulted Gross Lichterfelde for the purpose of improving their respective bricks. The comparative tests which were made proved immensely valuable to both associations and gave the ultimate consumer a far better building material than he would otherwise have been able to purchase.

Perhaps the Laboratory has done its most efficient work in co-operation with the technical associations of Germany—associations of engineers, manufacturers and technical men. Thus in conjunction with the Society of German Cement Manufacturers, the Laboratory conducted an exhaustive investigation which has resulted in a scientific standardization of Portland cement, and has definitely settled such nice points as the influence of high temperature on concrete, the effect of copper, lead and zinc on cement, and the comparative merits of Portland cement and iron slag Portland cement. Similarly, in co-operation with the Society of German Bridge and Structural Iron Builders, a painstaking study of the strength of rivets in steel girders was made.

A Study of Paper and Ink.

It must not be supposed that all German manufacturers have been broad-minded enough to submit their products to Gross Lichterfelde for approval. An attempt to analyze the various kinds of automobile gasoline sold throughout the German Empire, and to induce the wholesale dealers in gasoline to standardize liquid fuel so that the motor car owner could buy gasoline in Southern Germany exactly similar in quality to that sold in Northern Germany, was met by a flat refusal on the part of the dealers to assist the Laboratory. It is only a question of time when the Laboratory will succeed in carrying out its plan. Similar opposition was encountered when Gross Lichterfelde was commissioned by the government to analyze German papers and to determine their availability for bank notes, public documents and the like, an opposition that may be understood when it was discovered that only a very small percentage of German papers were found to answer the government's requirements. As the result of the work done at Gross Lichterfelde, the German paper manufacturer has so far improved his product that rarely indeed has he failed to fulfill government conditions. Opposition to the scientific investigations of the Laboratory has given place to the heartiest co-operation.

It was but natural that after paper was studied for the government the thousand and one inks sold in the German market should have been carefully analyzed and tested to determine their chemical composition and their ability to withstand light, fire, and weather. That investigation has only recently been completed. The government can now specify with scientific precision the characteristics of a wellnigh perfect ink to be used on its wellnigh perfect paper.

The standardization of manufactures is thus undertaken only for the government. The Laboratory, as a government institution entrusted with the scientific examination of material used by the government, can dictate the requirements which that material must fulfill; but it would not set up standards for the manufacture of articles for ordinary consumption. When a manufacturer requested the Laboratory to determine for him the qualifications that an asphalt should have for insulating purposes, he was told that the asphalt industry must frame its own standards, but that the Laboratory would assist him by giving scientific advice.

A Scientific Court of Last Resort in Technical Disputes.

As an impartial institution for scientifically passing upon the commercial availability of manufactured products, Gross Lichterfelde is required by law, when requested to do so, to settle technical disputes. Instead of wasting time and money in asking the courts to decide whether or not a contract has been carried out according to the spirit and the letter, the disputants often submit their case voluntarily to the Laboratory for decision. A builder ordered a large quantity of roofing tiles and specified that they were to be waterproof. When the tiles were delivered he refused to pay for them on the ground that they failed to comply with the conditions of the contract. The dispute was submitted to the Laboratory for decision. The tiles were tested and it was found that they were sufficiently waterproof to come within the meaning of the contract.

Even if a case does go to court, the Laboratory may be asked by the presiding judge to decide the technical point at issue. The decision is binding upon both sides—a veritable boon to a court confronted with a mass of conflicting expert testimony. In one case it appeared that in the construction of a wall a stone composed of crushed slag had been employed together with lime mortar. The mortar failed to harden. The dealer who had delivered the slag stone insisted that the wrong kind of mortar had been employed. The mortar maker retorted that the slag stone was worthless. The experts summoned by both sides failing to agree, as might be supposed, the court submitted the whole matter to Gross Lichterfelde. There it was decided that the mortar had failed to harden, not because it had been made with the wrong kind of sand (as one expert had declared) nor because the slag was of the wrong kind (as another expert had insisted), but because many lime mortars harden only when exposed to the air, and then only after they have been alternately moistened and dried. Hence, said Gross Lichterfelde, the core of a wall, as in the case in question, is not likely to harden at all, whether or not a slag stone or good brick is employed.

In another case the court called upon the Laboratory

(Continued on page 608.)

The Heavens in January

Constellations of Southern Skies

By Henry Norris Russell, Ph.D.

THE star-maps published every month in the SCIENTIFIC AMERICAN represent the sky as it appears to an observer in the latitude of New York (approximately 40 degrees north) and consequently fail to show the stars within 40 degrees of the south celestial pole, which are visible only in lower latitudes.

To meet the needs of observers in the southern part of the United States, or in more southern countries, the accompanying map has been prepared, showing all the stars clearly visible to the naked eye, within 60 degrees of the south pole.

The whole region of the heavens here represented can be seen at once only from points in extreme southern latitudes. From stations north of the equator, less than half of it is visible at any one time. It is, however, very easy to adjust the map so as to show just what southern stars are in sight from any given station, at any day and hour.

We need only know the observer's latitude (which can be obtained with sufficient accuracy from any good atlas) and the sidereal time. The latter can be found closely enough for our purpose by adding together three numbers: 1, the local time as given by an ordinary clock; 2, the quantity given in the accompanying table for the current month; 3, four minutes for each day of the month to date.

	h.	m.
January	18	39
February	20	41
March	22	32
April	0	34
May	2	32
June	4	34
July	6	31
August	8	35
September	10	37
October	12	35
November	14	38
December	16	36

Midnight should be counted as 12 hours, 1 A. M. as 13 hours, and so on, and, if the sum exceeds 24 hours, this amount should be subtracted from it. For example, for 1:15 A. M. on October 25th, we have:

	h.	m.
Clock time	13	15
From table, for October	12	35
$4 \times 25 = 100$ minutes, or	1	40
Sum	27	30
Subtract 24 hours.	24	0
Sidereal time	3	30

The results of this calculation will be correct within four or five minutes at the most, if the observer's clock keeps local time. If it keeps standard time, the result should be corrected by the amount by which standard time is fast or slow of local time. For our present purpose, this correction is usually hardly necessary.

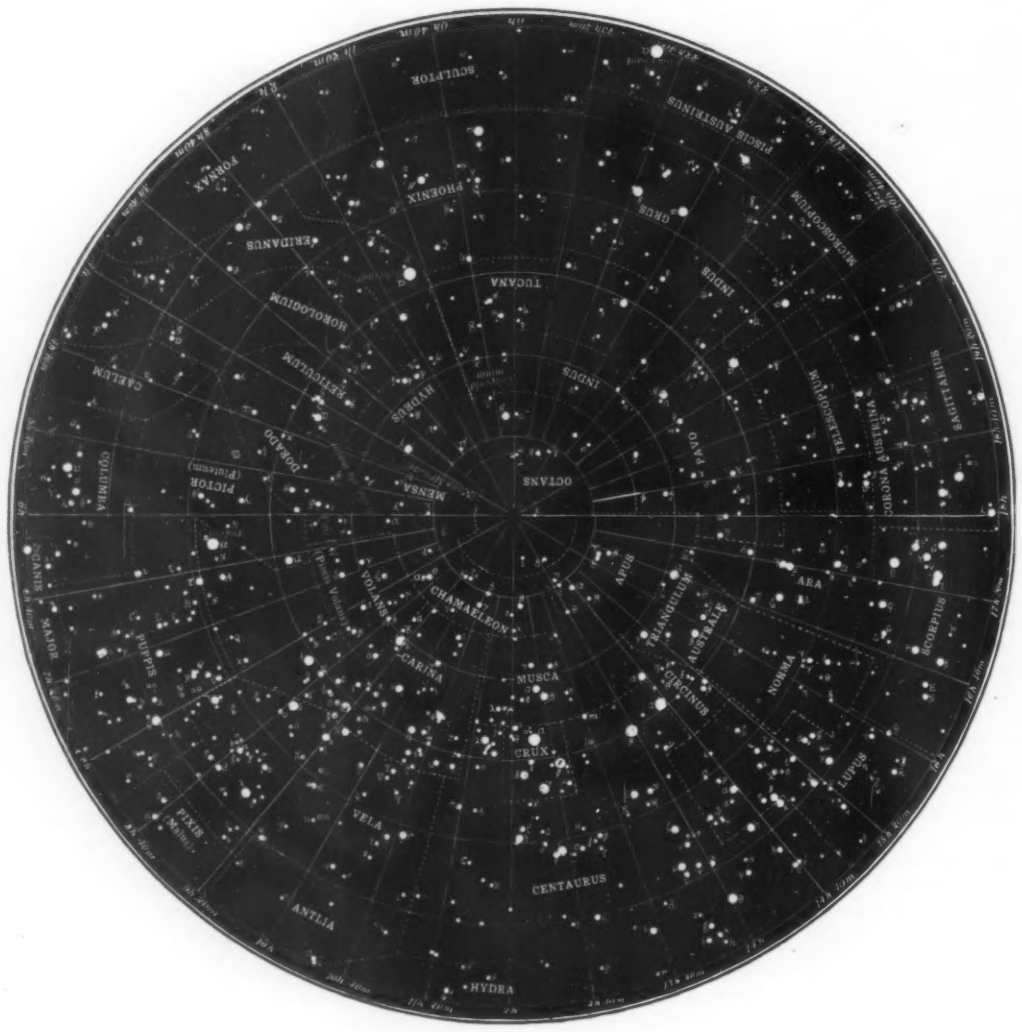
Find now the point on the margin of the map corresponding to the sidereal time, by means of the scale of hours and minutes on the edge, and turn the map till this point is at the top. Then lay a straight edge across it so that it passes above the center, at a distance equal to the observer's latitude (if north of the equator). As the white circles on the map are 10 degrees, 20 degrees, 30 degrees, etc., from the center, this can be done very easily. The part of the map above the straight edge then represents the southern sky, as it appears above the observer's horizon. In strict accuracy, the line representing the horizon should be curved, so as to be about one-third nearer the horizontal diameter of the map at the edges than at the center; but this too is of small practical importance.

For stations south of the equator, where the south celestial pole is above the horizon, the straight edge should be held below the center of the map, at a distance equal to the latitude. Stars in other parts of the sky than the south may be identified by the aid of the maps published every month. The present map is purposely made to overlap the southern portions of these by about twenty degrees, to facilitate passing from one to the other.

The familiar aspect of the northern heavens on a winter evening needs little description.

Orion and Canis Major blaze in the south, with Argo on the horizon below them. Gemini and Canis Minor are east and southeast of the zenith, Auriga directly overhead, and Taurus southwest of him. The planets Mars and Saturn, near together, between Taurus and Aries, increase the brightness of what is at all times the most brilliant region of the starry sphere.

Hydra, Leo, and Ursa Major are conspicuous in the eastern skies; Draco, Ursa Minor, and Cassiopeia in the north, and Perseus and Andromeda in the northwest. The only really dull region is in the southwest, which is filled rather than illumined by Pisces, Cetus, and Eridanus.



A CHART OF THE SOUTHERN HEAVENS

The Planets.

Mercury is morning star all through January. He is best seen about the 15th, when he is nearly 24 degrees from the sun. Being far south of the equator, in Sagittarius, he rises relatively late, about 5:45 A. M.; but he can be readily seen, before dawn, appearing as a star about as bright as Vega. Venus is likewise morning star, in Scorpio, rising about 4:30 A. M. in the middle of the month. Jupiter is a morning star, too, in the same region of the sky. On the 9th the two planets are in conjunction. Venus, which is about 1½ degrees north of Jupiter, appears about eight times as bright to the eye as he does, but in the telescope shows a disk little more than half as big. This very great difference in the apparent brightness of the surfaces of the two planets does not arise from differences in their reflecting power, but from the fact that Venus being relatively near the sun receives about fifty times the strength of sunlight that Jupiter does.

Mars is in Taurus, not very far from the Pleiades, and comes to the meridian at 8 P. M. in the middle of the month. He is rapidly receding from the earth, being 65,000,000 miles away on the 1st, and 88,000,000 on the 31st, and in consequence he diminishes steadily in brightness. At the beginning of the year he is twice as bright as Arcturus, and excelled only by Sirius, but at its end he is hardly equal to Capella.

Saturn is in Aries, about 10 degrees west of Mars, and appears about as bright as Procyon. His distance from the earth is so great—over 800,000,000 miles—that the forty millions by which it increases during the month makes but a small percentage of change in his apparent size and brightness.

Uranus is in conjunction with the sun on the 20th, and is invisible throughout the month. Neptune is in opposition on the 13th, and is well observable throughout the month. His exact position may be found at any time by interpolation between the two places:

	h.m. s.	deg. m.
Dec. 31..	7 37 58	+ 20 57.2
Feb. 1..	7 34 13	+ 21 6.2

This puts him very near the line drawn from δ Geminorum to a point found by carrying a line from β Geminorum through κ, and as far again. He appears as a star of magnitude 7.6, and can only be seen with telescopic aid.

The Moon is full at 7 A. M. on the 4th, in her last quarter at 2 A. M. on the 11th, new at 5 A. M. on the 19th, and in her first quarter at 3 A. M. on the 27th. She is nearest us on the 4th, and farthest away on the 17th. As the full Moon comes almost exactly at the time of perigee, we may expect unusually high—and low—tides on and about the 4th.

The Moon is in conjunction with Mars on the morning of New Year's Day, and an occultation is visible, in the morning hours, from points in the southwestern portion of the United States. She is also in conjunction with Neptune on the 4th, Jupiter and Venus on the 15th, Mercury on the 17th, Uranus on the 19th, Saturn on the 27th, and Mars again on the 28th, when a second occultation may be seen in the extreme north of this country.

A comet, visible in a small telescope, was discovered by the French astronomer Schaumasse on November 30th. It is moving slowly eastward through the northern part of Virgo, and increasing in brightness. On January 1st it will be in about 15 hours 15 minutes R. A. and 2 degrees south declination, moving about 1 degree east and 15 minutes south per day.

The first calculation of its orbit (by the discoverer and an associate) shows that it is still approaching the sun, and will not reach perihelion till February 5th, at which date it will be 108 million miles from the sun, and rather more distant from the earth. It will never be very near us, and in consequence may not be at all conspicuous; but it will be observable in the morning sky for some three months to come.

Princeton University Observatory.

Largest University in the World

REGISTRATION, now complete at Columbia University, shows that the attendance upon the university courses for the scholastic year is 7,468 as compared with 6,842 last year, an increase of 626, and, including the extension courses, the number is only eight short of 8,000. This places Columbia at the head of all other universities in the world in point of attendance, taking the place of Berlin, which stood at the head last year.

Progress of Work on the Panama Canal

Prospects of Completion by July 1st, 1913

THE original estimated date for the completion of the Panama Canal was January 1st, 1915. The work has advanced so rapidly that it has become apparent that the canal can be used at least a year earlier than this date. In order to determine the approximate time when shipping could pass through, a board was convened during the past year, composed of those charged with the work in progress and contemplated. Announcement was made that concreting of the locks at Gatun would be finished by June 1st, 1912, and the locks on the Pacific side four months later. Assuming that the gates were completed by June 1st, 1913, the contract time, the locks would be ready on that date, if the operating machinery were installed. The Gatun dam, it was estimated, would be finished by the close of the dry season 1912-1913, and if no more material, due to slides, had to be removed than was estimated at the time the board met, it was decided that the Culebra cut would be completed by July 1st, 1913. The exterior channels leading to the canal from the two oceans, it was found, would be sufficiently advanced to pass such shipping that would use the canal, by this same date, July 1st, 1913.

The report of Col. George W. Goethals, chairman and chief engineer, shows that progress during the past year has been eminently satisfactory. At Gatun locks, by the end of the fiscal year, the skeletons of four leaves of the gates were in position for a height of four panels, and those on the east chamber were completely riveted. At all of the locks, fender chains are to be placed 500 feet above and 230 feet below the upper and lower guard gates. When in use, they will be raised to the surface of the water, forming a barrier to the passage of ships. When it is struck by a vessel, the chain pays out against a resistance provided by hydraulic cylinders. The energy of a 10,000-ton ship moving four miles an hour will be absorbed after it strikes the chain before it reaches the gate.

Contracts for emergency or movable dams to check the outflow of water should the gates be carried away, have been awarded for $2,238,988, and all of these dams are to be completed by June 15th, 1913. Studies are being made of an electrical plant for operating the canal after completion, which contemplates a hydro-electric station on the Gatun dam, and a steam reserve generating station at the Miraflores locks.

A scheme for lighting the canal has been adopted. It contemplates the use of range lights for establishing the direction on the longer tangents, and of side lights, spaced about a mile apart, to mark each side of the channel. The project calls for the construction of 34 tower beacons of reinforced concrete, 57 beacons, 57 gas buoys, 76 spar buoys, and 7 nun buoys. There will be two parallel sailing lines, marked by range lights, which will be 250 feet apart; so that two passing ships, if on their ranges, will be 250 feet apart, center to center of ships.

Atlantic Division.

At the Gatun locks the excavation has been completed, except for a small amount at the north end of the lower locks. The concreting plant has shown great efficiency and capacity. The unloading cables have handled 500,550 cubic yards of crushed stone, and 241,858 cubic yards of sand. During the year, 945,525 barrels of cement were received into the storehouse, and in the same time an average of 6.08 of the eight 2-yard mixers furnished a total of 602,851 cubic yards of concrete. The total amount of masonry laid by the construction plant and by hand at the Gatun locks aggregated 911,137 cubic yards—a rate of 260.6 cubic yards per hour of service. The cost of the masonry was $6.64 per cubic yard. At the close of the year the masonry for the Gatun locks was 68.34 per cent completed. Over half a million cubic yards of backfilling was placed in the rear of the side walls of all the locks. A total of 31,060 feet of concrete piling was constructed for the foundation of the south middle approach wall, leading to the locks from Gatun Lake.

A total amount of 864,033 cubic yards of stone was crushed at the Porto Bella quarry at an average cost of 1.38 cents per yard, and from Nombre de Deos a total amount of 441,919 cubic yards of sand was obtained and transported in barges to Gatun, where it was transferred to the stock pile, at a cost, in the stock piles, of 1.86 cents per cubic yard.

Gatun Dam.

The Gatun dam has been formed by building two large rock embankments, and filling in the intervening space by hydraulic sluicing. During the year, on the east portion of the dam, the embankments have been raised from 65 feet to 85 feet above mean tide, and the hydraulic fill has been raised from 51 to 73 feet. On the west portion of the dam, the dry fill has been raised from 35 to 67 feet, and the hydraulic fill from 16 to 57.3 feet. The total increase of material, dry and wet, during the year has been 5,819,056 cubic yards. The cost of this work has been 38 cents for dry fill, and 23 cents for wet fill. The material for dry fill was brought by railway from Culebra cut, from the lock site, from Mindi, and from the spillway. The hydraulic fill was obtained from above and below the dam, and was placed by five suction dredges. The dam at the close of the fiscal year was 74 per cent completed.

Work on the spillway has proceeded very satisfactorily, and the concrete portion of the work is 66 per cent completed.

The channel between Gatun locks and the Atlantic is being attacked at several points, and 423,427 cubic yards have been removed between the locks and the Mindi hills. From the excavation through the Mindi hills 401,511 cubic yards have been removed by hydraulic dredge, and 280,000 cubic yards of earth and rock have been taken out by steam shovel. Between the Mindi hills and deep water in the Caribbean, the sea-going dredge "Caribbean," two dipper dredges, and three French ladder dredges have removed 4,516,369 cubic yards of earth and 487,038 cubic yards of rock, at a cost of 22 cents per cubic yard. The breakwater leading out from Toro Point has been pushed forward until, at the close of the year, 5,365 feet of double-track trestle had been completed, and 359,890 cubic yards of fill had been dumped from the trestle.

Central Division—Culebra Cut.

In the central division, the most important construction district is, of course, the great Culebra cut, from which during the fiscal year over sixteen million cubic yards were excavated, leaving, according to estimates of July 1st, 1911, about twenty-four million cubic yards yet to be taken out. The amount remaining has been increased during the year by 4,676,000 cubic yards, this to allow for the enormous slides which have developed, in the removal of which alone during the year, 4,880,000 cubic yards has had to be handled, which is over 30 per cent of the total amount removed from the cut during the year. The magnitude of this problem may be judged from the fact that thus far 10,757,000 cubic yards have been removed from slides, and the estimated amount remaining is nearly six million cubic yards. Col. Goethals states that slides follow the excavation in places where the material is left at a steeper slope than it will assume in its natural state; in which case it sloughs off until the natural slope is reached, and the movement ceases. Experience shows that it is only a question of time when these slides will cease entirely. Six of the good-sized slides are now quiet, and there is less trouble generally from this cause than at any time since the slides began to move.

A gratifying feature of this problem is the fact that, in spite of the enormous increase of 15,000,000 cubic yards of excavation due to slides, the reduction in unit cost, due to the splendid efficiency of the organization, will wipe out the extra cost of the slides, leaving the original estimate of excavating Culebra sufficient to cover the total cost of the work.

The average cost for excavation for the year was 59 cents per cubic yard, and at the close of the year the Culebra cut was 73.75 per cent completed.

Pacific Division.

The work of this division consists of the construction of the locks and dams at Pedro Miguel and at Miraflores, and the excavating of a channel between the locks, and from Miraflores locks to deep water in the Pacific. The total amount of concrete laid in the Pedro Miguel locks at the close of the year was 665,056 cubic yards, and the lock was 79.43 per cent completed. The locks at Miraflores, so far as the concrete work is concerned, are 19.27 per cent completed. As regards the channel between the locks and the Pacific Ocean, work has advanced satisfactorily between the two locks, and operations are being vigorously pushed upon the section lying between Miraflores locks and the Pacific Ocean. The dredges operating in the channel during the year were the 20-inch suction sea-going dredge Culebra, one dipper dredge, and three French ladder dredges. They removed from the channel a total of five and a half million cubic yards at a cost of 25 cents per yard, leaving a total of 4,700,000 cubic yards to be removed, including an estimate for siltage.

Towing Locomotives for the Gatun Locks.

By studying our front page engraving, it is possible to get a very accurate impression of the Gatun dam, with its spillway through the center, and of the massive concrete locks, through which access will be had to the Gatun Lake. The Gatun locks will be double, one set for ascending, and the other for descending vessels. They will be in three flights, and will have a total lift of 85 feet—this being the difference between the level of the surface of the lake and mean tide level of the Atlantic at this point. The locks lie some six miles from the Atlantic shore line, and the channel will be tidal up to the lower lock gates, with a small rise and fall of two feet—one above and one below mean level. (At the Pacific end, the rise and fall is 11 feet above and 11 feet below mean tide level.) The locks are the largest ever constructed, each having a width of 110 feet, and a usable length of 1,000 feet. Entering the canal from the lake, ships will find themselves guarded against running into the locks by fender chains which normally will lie at the bottom of the locks, but when a ship is entering will be stretched across the surface. As a further protection to the gates, there will be guard gates, placed some distance ahead of the main gates. These gates could be wrecked by an over-running ship without destroying the integrity of the canal and letting the water out of the lake.

Should a big vessel, becoming unmanageable, enter with such force as to carry away fender chain, guard gates, and the main gates themselves, an emergency dam is provided, by which the entrance to the locks could be closed. This dam consists of a massive swing bridge, which, in case of accident, could be turned so as to lie across the lock entrance. From the over-spanning bridge, a series of massive leaves of plate steel, extending entirely across the lock prism, would be lowered, gradually shutting off the flow of water, from below upward, until the wall of plates extended above lake level, when the entrance would be entirely closed.

Ships will not pass through the locks under their own power. Each ship will be taken in hand by four powerful electric locomotives, one off each bow and one off each quarter. The locomotives will each weigh 70,000 pounds. They will be driven by electric motors, operating gears which will engage a rack rail, and the hawsers from the ship will be attached to the windlasses of the locomotives, which will be provided with friction clutches, that will prevent the drums sustaining a pull of more than 25,000 pounds. The speed of the ships, when in tow of the locomotives, will be not over two miles per hour. The provision of rack rail traction, and the power and number of the locomotives, combined with careful operation, will practically eliminate any risks to the locks during the passage of vessels.

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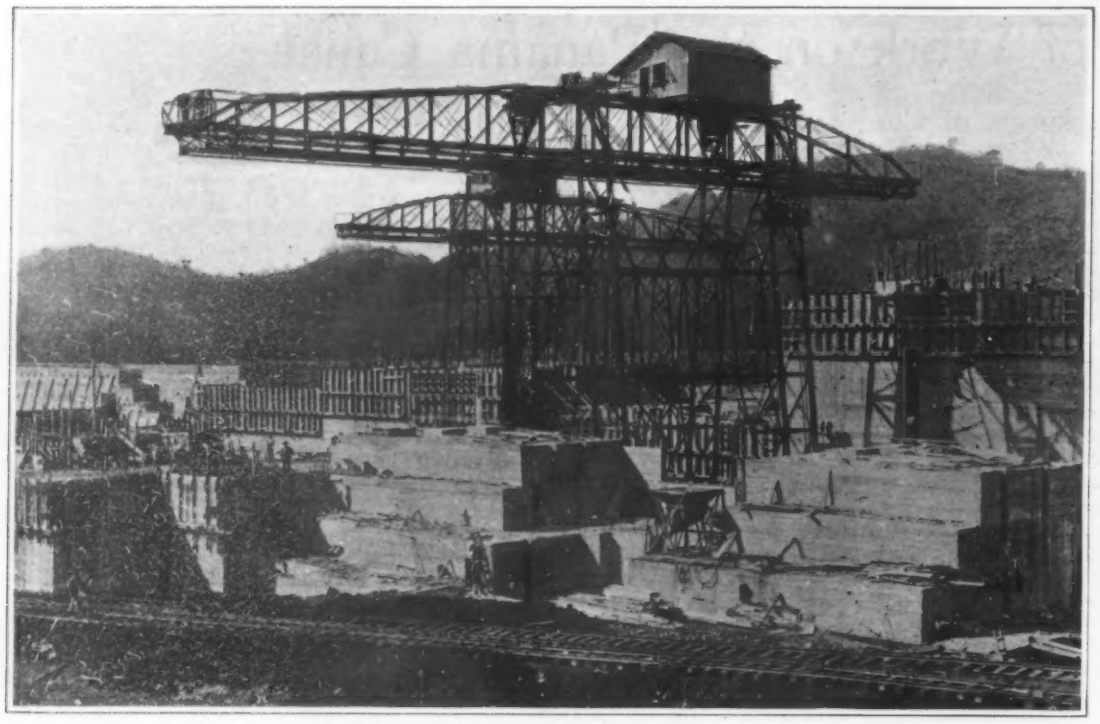
To Our Subscribers

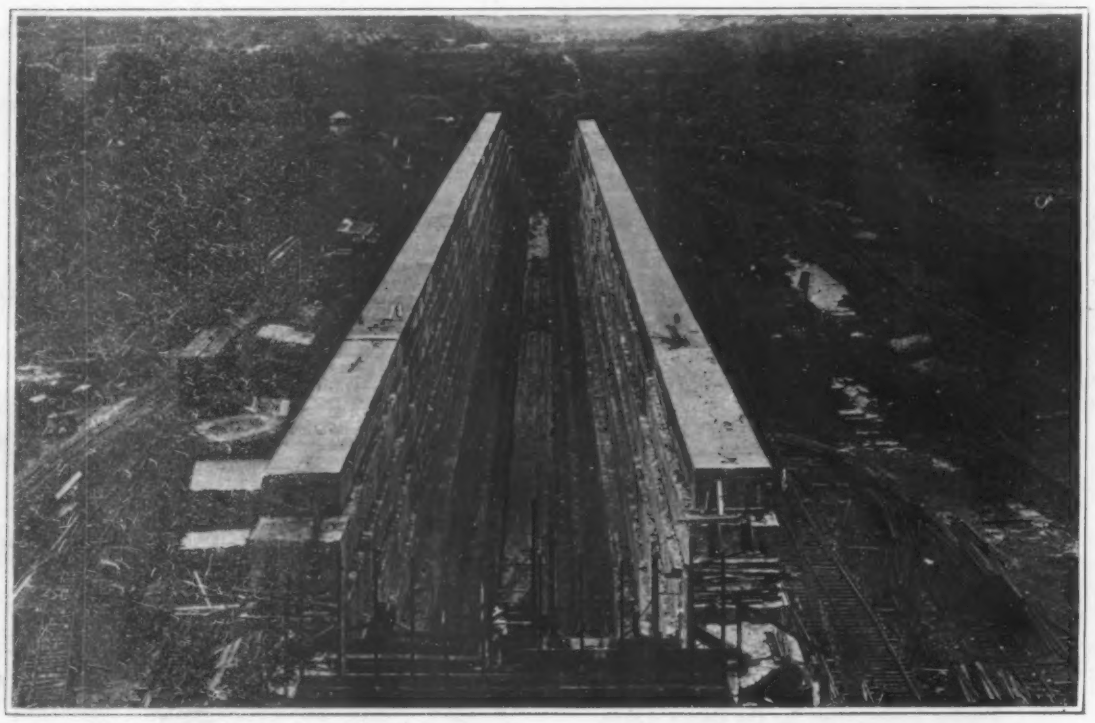
WE are at the close of another year—the sixty-seventh of the SCIENTIFIC AMERICAN'S life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year.

To those who are not familiar with the SCIENTIFIC AMERICAN SUPPLEMENT a word may not be out of place. The SCIENTIFIC AMERICAN SUPPLEMENT contains articles too long for insertion in the SCIENTIFIC AMERICAN, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the SCIENTIFIC AMERICAN and SUPPLEMENT the subscriber receives the benefit of a reduction in the subscription price.

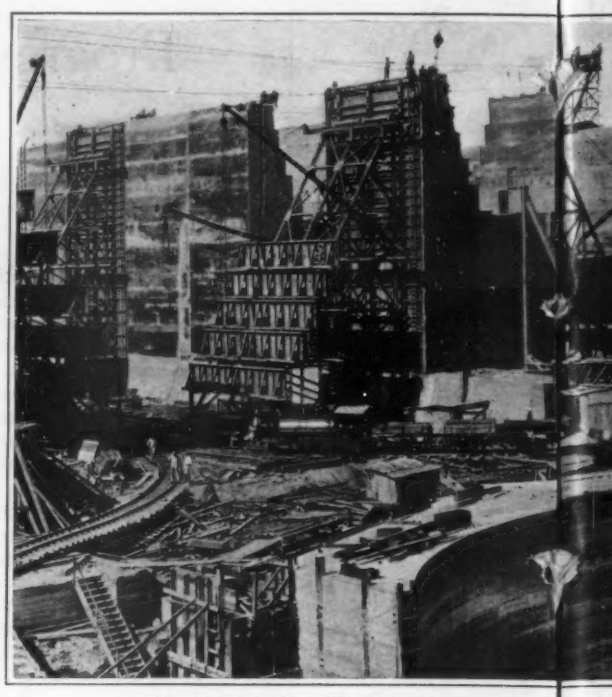


View of Pedro Miguel locks, looking west at intersection of center, and guide walls. The concrete walls are erected by means of the large cantilever crane.

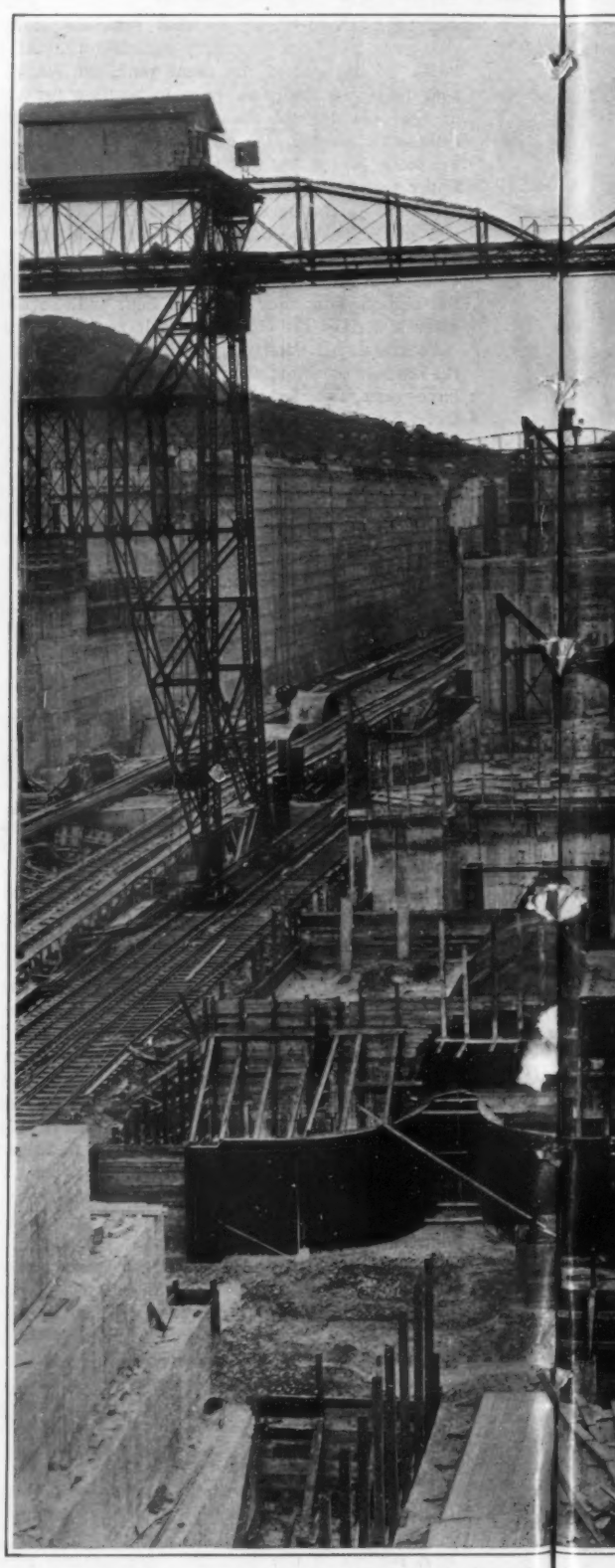
Looking north at the upper chamber of the east lock at Gatun. The bridge across the lock in the foreground is being used in connection with the erection of the gates of the lock.



Bird's eye view of one of the guide walls, looking south, taken from top of a chamber crane.



The Gatun locks. View showing south heads for

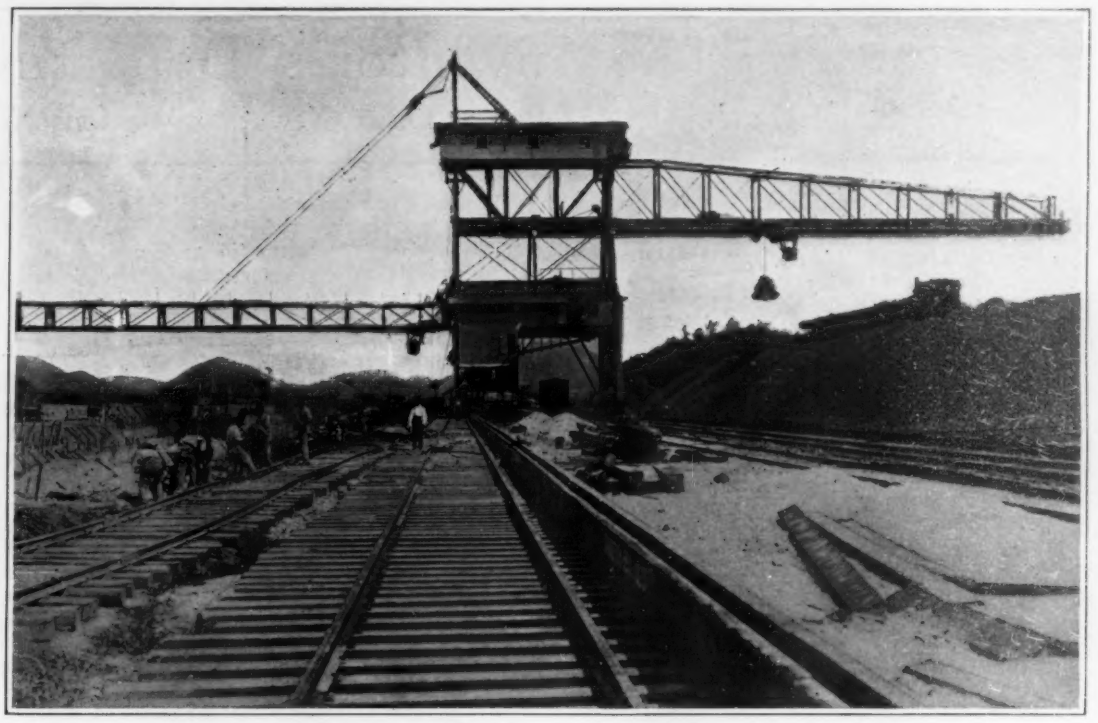


Pedro Miguel locks. View looking through lock along the of the

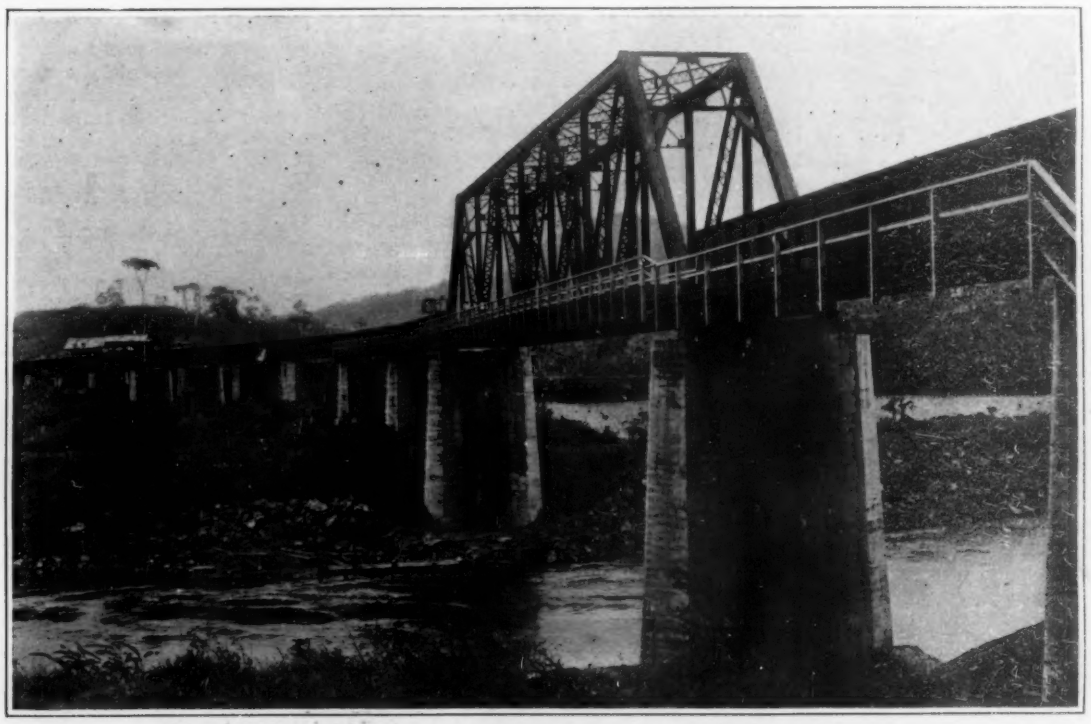
RECENT VIEWS OF WO

Photographs copyright by Under

heads for lower locks and end of middle lock.

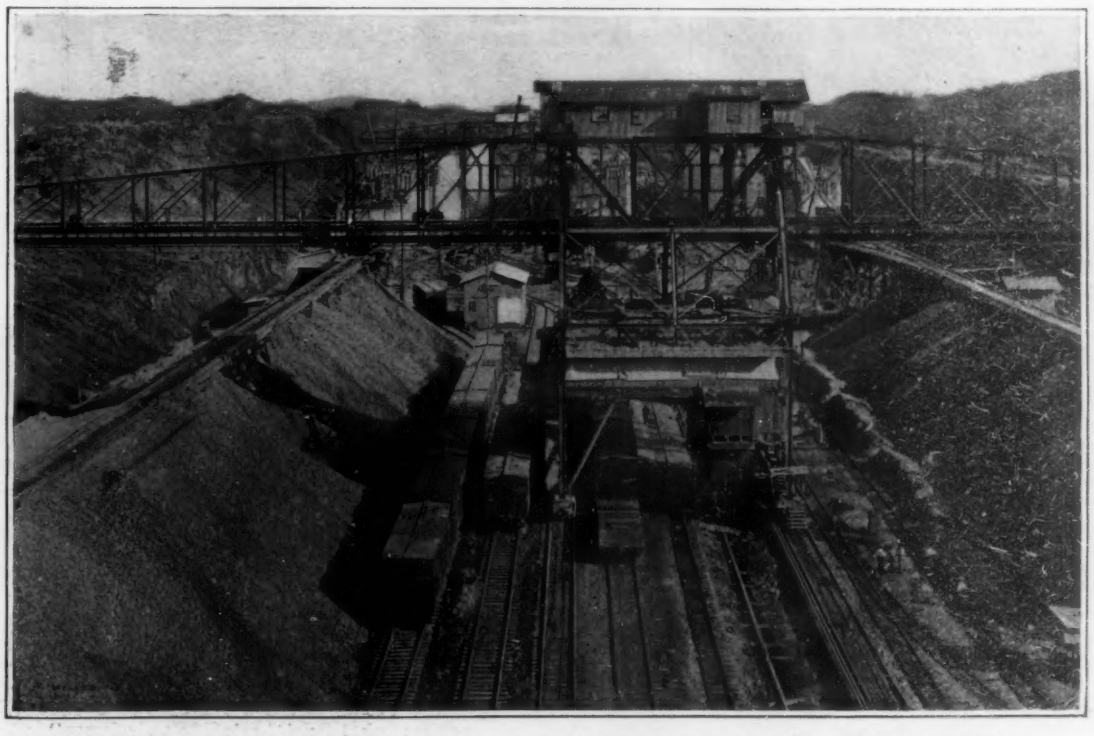


A view of one of the cranes at Miraflores. These are used for conveying the stone, sand, etc., from the stock piles to the mixers located in the base of the towers.



View of Gamboa Bridge, a permanent structure across the Chagres River. The waters of Gatun Lake will back up to about ten feet below this bridge.

he of the central dividing wall separating the adjacent locks.



General view of Pedro Miguel locks, looking south, from the top of a crane that is being dismantled.

OF WORK AT PANAMA

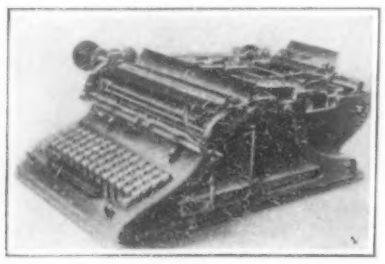
nt by Underwood & Underwood

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

A Typewriter for the Blind

IN view of the highly developed sense of touch in blind persons, the idea naturally suggests itself to construct a typewriter especially for their use, with the keys marked with the characters in raised type. A machine of this character, shown in the accompanying illustration, is the invention of M. Cayzergues, of Paris. Needless to say, when the operator has



A typewriter for the blind.

become proficient, the marks upon the keys are no longer necessary, and in fact the provision of raised characters upon the keys is the least of the special features required in a machine for the blind. What is needed is some arrangement whereby the operator is able to check up his work as he goes along and to correct any mistakes that may occur. With this in view, the machine which has been built is a combination of two separate printing mechanisms, both operated simultaneously from the same keyboard. One set of levers produces a record in raised characters on a paper cylinder, while another set at the back produces the usual written copy upon a separate sheet. The copy thus obtained represents the ordinary letter form as employed for business and other purposes, while the record on the paper cylinder is made in the special character used by the blind, consisting of a combination of small dots. In this way the blind writer is furnished on the one hand with a copy of his letter and on the other hand with a means for reading his writing as he goes along.

The new typewriter is not very much more complicated than the usual form. Each paper roller slides along a toothed rack in such a way that every time a key is struck, both carriages move along the distance of one tooth. The spacing of the lines is effected by hand by pushing a lever, so as to shift the roller carriages one space. The front carriage is arranged to operate the rear carriage through a rod and gear coupling. The raised record is so placed that the operator can run his fingers over it practically without interfering with his work.

When desired, the special mechanism for the blind can be disconnected and either part of the machine used separately.

Springless Truck for Rough Ground

THE accompanying engraving illustrates a very novel form of vehicle, which, by the use of eight wheels, dispenses with all springs, the wheels being so mounted as to enable it to travel over rough ground without being materially lifted by the obstacles over which it passes. A closer examination of the engraving will reveal the construction. Each wheel is mounted in a separate fork hinged to the frame above. The forks are connected in pairs by links running from crank arms on each to a common cross tree. As a result, should one wheel strike an obstacle, it would swing backward to clear the obstruction and in so doing would draw the cross tree backward, pulling its mating wheel forward. There would thus be a co-operative action between the two wheels in passing over the obstacle which would result in a practically level running of the vehicle body. Such being the case, there would be no necessity for springs. Of course, the truck body would not run perfectly level, but the rise and fall would be considerably less than with a four-wheeled truck of the ordinary construction. As most of the work done in drawing a vehicle consists in raising it over obstructions, it follows that the flexible wheel mounting here shown would call for much less tractive effort than is ordinarily the case.

Novel Cotton-picking Machine

THE machine which is pictured in the accompanying engraving is not completely automatic in its action. It is provided with a number of pickers, each of which must be separately controlled by an operator. The machine is driven by a three-horse-power kerosene engine, the entire outfit weighing about 800 pounds. The pickers operate somewhat on the principle of the spiral screw-driver. They consist of a shaft which rotates and at the same time has a reciprocal motion, so that it will alternately protrude and withdraw into a casing. The latter movement is produced by means of a guide with a double spiral groove. At the end of the shaft is a finger adapted to catch the cotton boll and twist it out of its pod, after which the picker is withdrawn within its casing, the boll is stripped from the finger and carried by means of an air blast through a cleaner that removes any leaves or sticks that may adhere thereto, and deposits the clean cotton in a bag. The picking finger is operated by means of a flexible shaft, while a separate flexible tube runs to the picker to convey the cotton to the cleaner. By providing individual control of the pickers, the cotton may be picked from parts of the plant which might be inaccessible to a purely mechanical machine. On a test with the cotton picker illustrated, two men being employed, a hundred pounds of cotton was picked per hour.

Cotton picking machine with hand-controlled pickers.

The springless truck thrown on its side to show the compensating wheel gear.

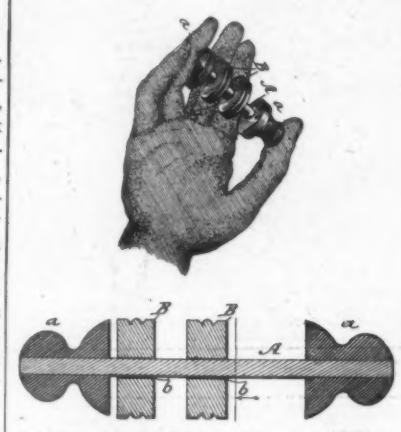
Youngest Patentee of Record

THERE is no age limit to patentees. Take the patent, No. 465,066, of December 15th, 1891, to Donald M. Murphy, of St. John, Canada. One might think from his X mark signature to the specification that Donald could not write his name, and he could not, for he had no book learning, but he did have the inventive ability to produce a sounding toy for which the United States Patent Office granted him a patent. But do not blame him for his lack of schooling, for Donald was only six years old when he filed the application, and as far as is known the youngest applicant for patent in this or any other country. His picture formed a part of the Patent Office Exhibit at the Chicago Worlds' Fair in 1893. The toy patented to him is a simple contrivance including a bar with handle knobs at its ends and two clapper disks slidable along the bar so they can sound against each other and against the handle knobs. See accompanying illustration.

Notes for Inventors

Death of Thomas Hall.—Thomas Hall, known for his inventions in connection with the manufacture of typewriters, died recently at the age of 77. He won a prize at the Paris Exposition of 1867, by the exhibition of a keyed typewriter. Mr. Hall also invented a number of sewing machine attachments and an improved drill grinder. He was born in Philadelphia, February 4th, 1834.

Fire Arm for Stage Use.—Most of us cannot shoot straight with a revolver designed for straight shooting, but to make sure of this John E. Banner, of Mt. Airy, N. C., has patented (No. 1,007,174) a shooting implement in the form of a revolver which has the muzzle end of the



Clapper invented by a six-year-old boy.

barrel closed and its bullet passage or bore deflected at its discharge upwardly and out through the top of the barrel so the bullet will pass almost vertically upward.

A Cloud Protector for Aeroplanes.—Army and navy ordnance experts are giving much time and thought to the best manner of attacking airships aloft. Various guns for firing at the fliers have been invented. "Is it not practicable," says one of our correspondents, "to provide some means, chemical or otherwise, by which the aviator can, at his pleasure, produce some cloud like vapor to envelope his machine and obscure it from the view of the enemy? The artificial cloud might be visible, but would only form a large target while the machine, the real objective point of the firing lines, would form only a small part of the target, decreasing in proportion to the size of the cloud the prospect of being struck by the projectiles."

Color Changing Fláming Arc Lamp.—Color effects in arc lamps are sought by a patent, No. 1,007,869, to Chas. W. Hill, of Lakewood, Ohio, assignor to National Carbon Company, of Cleveland, who provides an electrode for flaming arc lamps, in different portions of which are incorporated different substances, adapted as they volatilize, to give to the arc stream a characteristic color, thus imparting a succession of color changes to the arc as the electrode is consumed.

Prevents Hen from Setting.—Setting hens are proverbially persistent but Vern M. Osborn, of Los Angeles, in patent, No. 1,008,050, furnishes a poke like device which he straps on the hen showing setting proclivities, the device being provided with a pair of legs which project down in front of the hen's legs so that she cannot assume her usual posture on the eggs.

A Hewitt Vapor Converter.—Peter Cooper Hewitt of Ringwood Manor, N. J., has secured a patent, No. 1,007,694, for a vapor rectifier in which a container has a conducting receptacle with hollow arms extending from it and conducting caps, constituting the terminals of the arms and forming the main positive electrodes of the apparatus, while the negative electrode is contained in the receptacle.

A Multi-blade Safety Razor.—A razor described in patent No. 1,007,847, granted to Axel Anselin Carlson, of Lindsborg, Kansas, has a casing and a blade guard. A carrier having a number of blades is revolubly mounted in the casing so that any one of the blades which are removably and yieldingly mounted in the casing may be brought into operative position relatively to the guard.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

DRYING AND STRETCHING FRAME.—C. WINKLER, 1646 Amsterdam Ave., New York, N. Y. This invention relates to apparel apparatus. It provides a frame more especially designed for drying stockings quickly and in pairs to prevent misplacing of mated stockings and to prevent the stockings from shrinking, the frame also permitting of convenient adjustment to readily accommodate stockings of different sizes.

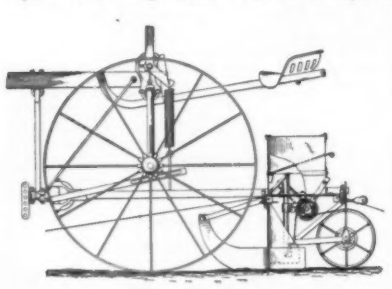
EAR MUFF.—W. H. FRENCH, Evansville, Ind. An object of this invention is to provide a strong and simple ear muff which serves efficiently to cover and protect the ear against the injurious effects of cold, wet, wind, etc., which is compact in form, and which is so constructed that it can be securely held in place without the use of a spring bow or other devices.

ELECTRIC TIME SWITCH.—C. J. LINDEWALD, 312 Dean Building, South Bend, Ind. An object here is to provide a device which is controlled by clock-work, and which may be set to close a circuit at any predetermined time, and to open the same subsequently at any predetermined time. A further object is to provide a device in the nature of an improvement to an ordinary clock for accomplishing the closing and opening of the switch.

Of Interest to Farmers.

COW STANCHION.—F. A. BRUNDAGE, Box 33, Belmont, N. Y. This invention relates generally to cow stanchions, and more particularly it involves an improved form of stanchion having means whereby the movable bar in the stanchion may be locked and unlocked. The stanchion has an improved locking means whereby the movable bar may be easily and quickly brought to either operative or inoperative position.

AUXILIARY PLANTER.—A. R. BALDWIN, care of Rogers and Baldwin Hardware Co., Springfield, Mo. The accompanying illustration shows a side view of a planter constructed and arranged in conformity with the present invention, pictured in conjunction with an independent hauling truck. The advantage is

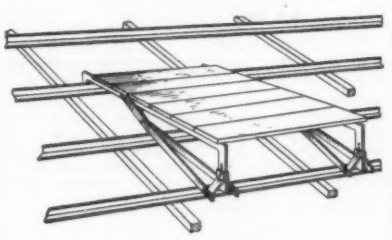


AUXILIARY PLANTER.

obvious, as it enables the planter to be used in conjunction with any other suitable farm implement. As an instance, it will be conceived that to attach a planter thus constructed to follow gang plows or harrows would serve to shorten the operation of preparing the field by just so much time, cost and labor as would be needed to plant the field after the bed has been prepared, as is the present custom.

Of General Interest.

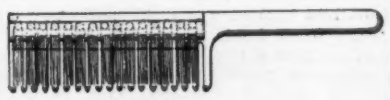
ADJUSTABLE BRACKET.—P. WHITE, 152 Academy Street, Long Island City, N. Y. This invention relates to a form of bracket for scaffolding, more particularly adapted for use by tile setters on sloping constructions. The objects of the inventor are obtained by constructing a bracket of a general triangular shape, having an adjustable hook depending



ADJUSTABLE BRACKET.

from one end to fit over a metallic framework of an unfinished roof, positioning two of these brackets apart on the roof and connecting the same by a scantling of board or boards to form a readily constructed bracket. The perspective view herewith shows an embodiment of the invention applied to a roof construction.

COMB AND BRUSH.—W. J. HOPE, Tunica, Miss. This invention is an improvement in a comb and brush, and the aim is the provision of a simple, compact and cheaply constructed device combining the functions of both instruments, as shown in the engraving, which will be capable of being carried in the pocket, will not easily collect dirt, and which may be easily cleaned. It is handled in the same manner as an ordinary comb. As the teeth pass through the hair, the bristles smooth the hair



COMB AND BRUSH.

both in front and behind the teeth. Either set of bristles may be used alone by inclining the comb, or the teeth may be used with both. Only a slight portion of the length of the teeth extends below the bristles.

GUITAR.—A. DEGULIO, 1261 Lynd Avenue, High Bridge, Bronx, N. Y. The invention relates generally to stringed musical instruments and more particularly it involves an improved construction of body of a guitar. From the engraving it will be seen that the bridge is supported entirely by the sounding board, being out of contact with the top of the body,

GUITAR.

this construction affording an increase in volume and an improvement in the tone of the sounds since the free vibration of the board is not interfered with in any way by the hands when playing; the vibration of the strings is transmitted directly to the sounding board and none of the energy of vibration is dissipated in through contact with the body since the bridge rests on the sounding board.

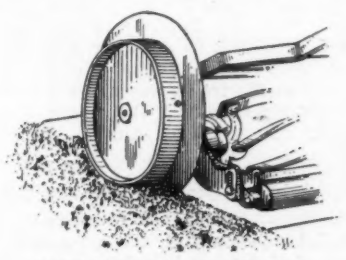
UNSINKABLE BOAT.—J. PASTOREL, P. O. Box, 947 Asbury Park, N. J. The frame is constructed of hard rubber and is covered with sheets of rubber or rubber cloth in such a way as to form independent air-tight compartments, inflated to increase the boat's buoyancy. Elasticity of materials used enables the structure to incur severe blows and shocks, because, when subjected to rough usage, the boat will

UNSINKABLE BOAT.

yield instead of breaking, as it might in case common material, such as wood or iron, were employed. The object of the inventor is to produce a vessel which will be lighter, faster and better able to resist damage than any other vessels of the same description. The engraving shows a side view of the framework.

Hardware and Tools.

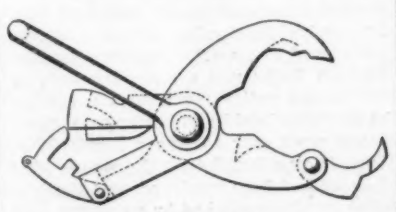
LAWN TRIMMING ATTACHMENT.—W. E. HILL, Charleston, Ill. It is the purpose in this invention to provide a lawn trimming or edging attachment of novel form and design, which may be detachably secured to a wheel of an ordinary lawn mower, as pictured in



LAWN TRIMMING ATTACHMENT.

the accompanying engraving, and when in position may be efficiently operated, with a minimum of time and labor required, to cut off all grass projecting outward over the edge or border of a grass plot, and to trim the face of the turf or sod in a uniform and symmetrical manner. The device may be operated by an unskilled operator.

SAFETY HOOK.—R. LANGE, care of Hugo Lange, Okanogan, Wash. This device is adapted



SAFETY HOOK.

to carry a load of cranes, or used as a harness hook or other readily-releasable connecting device suitable for carrying a load or resisting a strain. To this end the hook in general comprises two hook members pivoted together to swing to and from each other, one of the hook members having a gate adapted, when the hook members are closed and locked, to swing inwardly and permit the insertion and removal of the suspension link, the gate arranged at the mouth of the hook to take the strain on the link. The illustration shows the hook members released and swung apart.

Household Utilities.

BROILER.—J. W. TAYLOR, Box 93, Antigonishe, Nova Scotia, Canada. In this patent the invention has reference generally to broilers and more particularly it relates to those articles of this class which comprise a pair of extended body portions suitably hinged together and between which articles of food are held over the fire in order to be cooked, and held in a manner that will not permit the food falling out.

CONVERTIBLE CHAIR.—A. DEMERS, 461 Granite Street, Manchester, N. H. This invention has reference to convertible chairs, and it has for its purpose the provision of a rocking chair which may be readily converted into a cradle, a cradle member being normally dis-

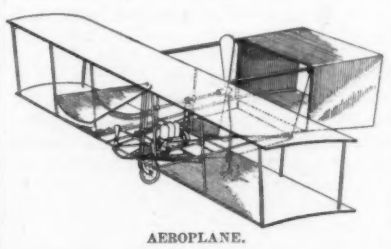
CONVERTIBLE CHAIR.

posed under the seat of the chair, which may be erected across the front of the chair to form the side member for the cradle, the sides of the chair being adjustably mounted so that they may be lowered to a horizontal position to form the head and the foot of the cradle. The chair is pictured in perspective in the accompanying illustration.

Machines and Mechanical Devices.

CHECK PROTECTOR.—C. H. SAMPSON, Rochester, N. Y. This invention refers to protectors employed for providing a check with a mark pressed into the paper and representing a certain sum, and the words "Not over." It provides a protector arranged to permit the user to view the line of the check where the printing is to take place, and to provide a single hand lever mechanism for controlling the movement of the printing parts.

AEROPLANE.—G. W. THOMPSON, Kingston, Okla. This invention relates to flying machines of the heavier-than-air type, and the object is to provide a machine of this class which has its propellers so arranged that they not only drive the machine but steer it also. By such a construction the inventor minimizes the necessity of using movable rudders here-



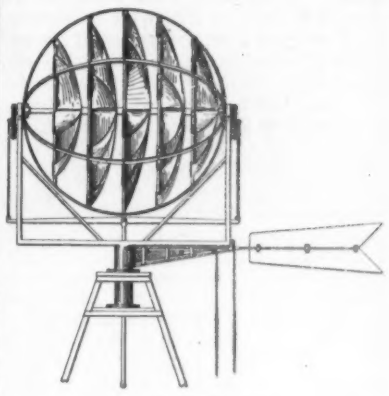
AEROPLANE.

tofore used to control the machine's course of travel. Balancing is accomplished by locating the power plant directly below the center of gravity of the supporting planes, and by the manner in which the planes are tilted with reference to the line of travel. The improved aeroplane is shown in perspective in the accompanying view.

FLYING MACHINE.—R. COLE, Norwalk, Ohio. This improvement relates to a flying machine, and particularly to aeroplanes in which an automatic balance of the equilibrium is obtained. A further object is to provide a flexible connection between the main supporting plane and the frame, whereby the equilibrium of the aeroplane is automatically maintained.

FLUID PRESSURE TOOL.—A. C. MCFARLANE, 601 North Wahsatch, Colo. The object of this invention is to provide a fluid pressure tool, arranged for running the tool at a high speed and with economy in the use of the motive agent, to reduce jar and vibration to a minimum and to prevent breaking of the operating parts, especially when the tool is running without the drill being in place.

WINDMILL.—C. F. CRADDICK, 514 W. Porphyry St., Butte, Mont. The accompanying engraving shows a side elevation of a windmill constructed and arranged in accordance with the present invention. The principle objects in view in this case are: to provide a power head for a windmill disposed and ar-



WINDMILL.

ranged as a series of turbine-shape rotating members; provides a power head having a maximum wind pressure surface disposed in power relation to the wind, and having the maximum of exposed surface when disposed in angular relation to the wind; and to provide regulating means for automatically varying the pressure under operative conditions.

Prime Movers and Their Accessories.

ELASTIC FLUID TURBINE.—R. HARRISON, 58 Chancery Lane, London, England. In this patent the invention has for its purpose the production of an efficient turbine of simple and strong construction having the steam nozzles, exhaust openings, and connecting channels so arranged that the work to be done by the steam shall be distributed over two or more stages arranged around the circumferenec of a single rotor.

CARBURETER.—W. A. HARRIS, 217 John St., Greenville, S. C. The invention in this case is an improvement in carbureters, and the purpose of the inventor is the provision of a carbureter of the character specified, for use in vaporizing gasolene and mixing air therewith in the most favorable proportions for the most efficient combustion.

Railways and Their Accessories.

RAILROAD TIE SPACER.—J. W. WOOD, Needles, Cal. In the present patent the invention is a spacer for railroad ties, and it comprises a device which can be readily placed in position to grip the top of a rail, and which acts as a fulcrum for the spacing bar which is used to force the ties into proper position.

BRAKE BEAM AND FULCRUM THEREFOR.—J. B. SIMPSON, Easton, Pa. This improvement refers to brake beams and fulcrums therefor, and it has for its object to provide a fulcrum member having means by which it may be conveniently secured to a T-shaped or other beam, without slipping the fulcrum over the end of the beam, and without splitting the fulcrum member.

Pertaining to Recreation.

TRAVELING ROCKING HORSE.—W. ROBERTS, 702 W. Mulberry St., Springfield, Ohio. This improvement has reference to traveling rocking horses and the object is to provide one which is propelled by means connected to a rock shaft to which the horse is secured, stirrups being provided which are connected with steering mechanism by which the direction of travel may be controlled.

Pertaining to Vehicles.

VEHICLE TIRE.—E. TALLMAN, Morley, Iowa. The invention provides a resilient tire constructed of spring metal to avoid disadvantages in the employment of rubber tubes of usual construction; provides a tire constructed from a series of sectional forms each detachable and replaceable; provides an articulated tire of metallic sectional springs, each co-operatively connected with adjacent springs to unify the action of the springs; provides a tire with stop members to reinforce the tire structure to avoid the breakage of single sectional springs when subjected to sudden strains; and provides for a tire a wearing shoe constructed from a series of assembled short removable sections.

Designs.

DESIGN FOR CARPET OR RUG.—J. S. BROWN, care of G. S. Squire, Hartford Carpet Corp., 41 Union Square, New York, N. Y. This design for a carpet or rug is oblong in form and exquisitely ornamental in composition. Inside and near the edge there is an elaborate border of figures in a white ground and a mass of small dotted circles separates this border from a bright centerpiece in a white field. Mr. Brown has patterned another carpet or rug design of the same shape, with a rather dark and brilliant mixed border separated from the centerpiece by a scrolled work runner in a white field. The centerpiece is elaborate and abounding in arrangements of flowers.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Retrospect of the Year 1911

(Concluded from page 591.)

plane. On January 30th, McCurdy attempted to fly from Key West to Havana. After covering ninety miles out of the one hundred in two hours, he fell in the sea, owing to a burned-out bearing on his motor. Mr. Glenn Curtiss first succeeded in rising from the water, with his biplane equipped with floats, at San Diego, on January 26th. Thus was born America's first hydro-aeroplane. Curtiss constructed a number of these machines, several of which have been supplied to our navy and one to that of Russia, which is very active in aviation. Using one of them, Hugh Robinson flew several hundred miles down the Mississippi from Minneapolis, carrying mail, which he left at the towns *en route*. The mail-carrying experiments made on a larger scale at the aviation meet at Nassau Boulevard, together with Robinson's demonstration, convinced Postmaster-General Hitchcock that the aeroplane can be used successfully for delivering mail to inaccessible places. Many exhibition flights have been made in America this year, the most daring and thrilling of all having been Lincoln Beachy's dip over Niagara Falls and flight through the gorge, which he made with a "headless" Curtiss biplane.

The chief development in aviation this year has been the change from the exhibition flight to the long-distance, cross-country race or tour. A half dozen big races, such as the Paris-Madrid, Paris-Rome, European Circuit, Circuit of Britain, etc., were flown successfully abroad and were practically all won by monoplanes, which appeared to be faster and safer than the biplanes. In America, however, Beachy and Ely gave some marvelous exhibitions of flying in strong winds with the latter type of machine. A Maurice Farman biplane, on March 7th, made the 225-mile flight from Paris to the Puy-de-Dome Mountain, without a stop, and carrying two men. Eugene Reneaux, the pilot, thus won the Michelin $20,000 prize which had been offered exactly three years before. Vedrines, on a Morane monoplane, won the Paris-Madrid race and secured second place in the 1,060-mile Circuit of Britain. This English event, as well as the Paris-Rome and the European circuit, was won by Lieut. Conneau, of the French navy, while Roland Garros was second in the two latter races. Both of these aviators used Blériot monoplanes. The Paris-Madrid race of 900 miles was covered in four days, and the Circuit of Britain required but three days' flying by Conneau and Vedrines. The two other machines which finished required thirteen and fourteen days respectively. M. Garros, on September 4th, made a new height record of 4,252 meters (13,950 feet), thus beating by 2,370 feet the record of Beachy at Chicago, and climbing some 750 feet more than 2½ miles above the earth's surface.

Last summer, Harry N. Atwood flew from Boston to Washington with his Wright biplane, carrying a passenger most of the way. Later, he flew from St. Louis to New York, by way of Chicago, in fourteen days. Enthusiastic over his success, Calbraith P. Rodgers and Robert G. Fowler started to fly across the continent from New York and San Francisco respectively. Both aviators used Wright biplanes, and were accompanied by special trains, carrying spare parts. After three unsuccessful attempts at climbing over the Sierra Nevada Mountains, Fowler finally flew by the southern route, which was the one chosen by Rodgers. Rodgers left Sheepshead Bay on September 17th. His route was *via* Chicago, St. Louis, San Antonio, and El Paso, Texas, from which State he followed the Southern Pacific Railroad. He finally reached Pasadena on November 5th. In flying the 25 miles from there to the Pacific Ocean, he sustained a bad fall and was laid up several weeks. Finally, on December 10th, he finished the first trans-continental aeroplane flight. He passed Fowler at Tucson, Ariz., and the latter has now progressed almost as far as New Orleans.

Orville Wright conducted some experiments with a 145-pound glider at Kitty Hawk, N. C., late in October. These experiments were of great interest from the fact that Mr. Wright succeeded in rising in the teeth of a 50-mile gale and remaining aloft once for 7¼ minutes, and again for 9¾ minutes. In the shorter flight, he hovered for five minutes above a given spot. Mr. Wright obtained valuable information relative to the designing of a machine with flattened surfaces, capable of flying in the strongest winds.

To the death list of flyers, numbering this year 76 should be added the loss of Octave Chanute, who was known as America's "Father of Aviation," and also that other pioneer, Prof. John J. Montgomery, of Santa Clara College, Cal. The latter was killed while experimenting with a new glider. A large number of the fatal accidents were due to recklessness and foolhardiness in making exhibition flights; but there have also been accidents from breakages of machines. The causes of the various accidents have not all been determined, but the proportion of deaths to the number of miles flown is without doubt less than in 1910. The carrying of as many as six passengers on cross-country flights of one hour, and the development of an aerial taxicab, which has flown successfully, has put heart into those who believe the aeroplane has a future as a means of public rapid transit. It will also undoubtedly be used for the regular carrying of mail in the near future. The severe tests for French military aeroplanes resulted in seven machines making a flight of 186 miles without a stop, when carrying two men and 660 pounds of dead weight. The winner was a Nieuport monoplane, piloted by Weymann, the American aviator, who also won the International Cup race for this country with the same make of machine on July 1st last. He made an average speed of 72 miles an hour in the military contest, with a 70-horse-power monoplane, whereas, in the International race, he made 78.1 miles with a 100-horse-power motor.

The development of the dirigible balloon has resulted, in Germany, in a passenger-carrying rigid airship, the "Schwaben," which has made numerous sight-seeing trips about the Fatherland, running, on schedule, with a regularity which has strengthened the belief in the commercial and military future of the dirigible. The "Schwaben" developed a speed of practically 43 miles an hour, with 450 horse-power, when accurately tested over a measured course. In France, the non-rigid dirigible has been developed to a point of gratifying efficiency, and the government is building additional Lebaudys for the use of the army. For scouting, the aeroplane is simpler and, in many ways, superior to the clumsy airship. At Tripoli recently, Italian aeroplanes are reported to have dropped bombs upon the Turkish troops, with disastrous effect. The huge English dirigible, the "Mayfly," broke in two when being drawn out of its shed, and as a consequence opinion in Great Britain is more favorable to the aeroplane. Two airships, the "Suchard" and the "Akron," were constructed this year in Germany and America for the purpose of crossing the Atlantic. The former is to start from the island of Teneriffe, and the latter from Atlantic City. Neither was completed in time to attempt a flight this year; but it is probable that next spring both will start in this great attempt. Mr. Vaniman, after his experience with the "America" in 1910, has constructed a new and larger airship, from which he believes he has eliminated the troubles which led to his previous failure.

A Dark Substance in Space

IN the vicinity of the star S Coronæ Australis Innes and Worsell have found a patch of sky 25 minutes of arc in diameter where no star can be seen with a 9-inch refracting telescope. According to Innes, who discusses the subject in "Transvaal Observatory Circular No. 5," the apparent absence of stars in this region is due to the occurrence of some absorbing medium, interposed between us and distant parts of the universe. Stars in the neighborhood of the dark region are enveloped in nebulæ; while just on the border of it there is a star which has been observed to fluctuate in magnitude between 11.0 and 12.2, and which was invisible during the years 1899-1901. The latter fact is accounted for on the supposition that the absorbing medium was for a time in front of the star, but has since withdrawn from it.

The Most Remarkable Testing Laboratory in the World

(Concluded from page 595.)

to decide whether or not a certain lubricant had spoiled a suit of clothes. The judge washed his hands of the matter and submitted the lubricant to the Royal Laboratory for Testing Materials. With characteristic thoroughness the Laboratory experimented with stains which were produced by the lubricant. First, it determined whether the stains could be eradicated by washing or only with the aid of special solvents, or not at all. Then it determined whether the color of the cloth had suffered as the result of attempting to remove the stains. Finally, it ascertained whether the strength of the cloth fiber had been impaired by the process of cleaning. It reported to the court that stains made with the lubricant on cotton, wool and linen could be easily removed; that the lubricant had no injurious effect on the dyes employed, and that the lubricant did not weaken the fiber, even after prolonged intimate contact—in a word, that the cloth was not irretrievably spoiled.

Settling Patent Infringement Suits.

In patent infringement suits, as might be expected, the Laboratory does yeoman service for the court. It does not construe claims, for that is a matter of law; but it determines matters of technical fact, with the result that a judge is spared the necessity of considering a mass of testimony which, to a layman in science, even though he be a lawyer, must seem a hopeless jumble of cryptic phrases. One such case turned upon the point whether or not a certain brand of soap was so greatly superior to another in washing qualities as to be patentably different. On behalf of the court, the Laboratory made a study of the two soaps to determine their solubility in water, acids and lime solutions, and their effect on dyes and on fabrics. It showed conclusively that the one soap was no better than the other.

These opinions of the Laboratory on matters of technical fact are by law made binding upon the courts. A judge must accept the technical decision of the Laboratory and rule accordingly.

Germany has a tariff, which, like our own, is intended to protect the home producer. Disputes with the customs authorities are therefore as frequent in Germany as in the United States. The American appraiser submits imported goods for scientific examination either to chemists or physicists in the employ of the customs service, or else he employs outside experts. The German customs authorities call upon the Royal Laboratory for Testing Materials for assistance. In a controversy which arose between the customs authorities and an importer of mercerized cotton, the government maintained that the fabric was dyed and therefore subject to a higher duty than if it were undyed. The importer insisted that the cotton was undyed. Gross Lichterfelde examined the fabric scientifically and supported him in his contention.

An American Appeals for Scientific Help.

Foreigners, too, resort occasionally to the Laboratory when the questions at issue affect German industry. I was told of an American importer of German paper who had been compelled, as he thought, to pay a higher duty in the United States than the Dingley tariff required. Because the importation was an oily German paper substitute for parchment, he asked the Laboratory to tell him how treated papers could be scientifically distinguished from untreated papers. He received an exhaustive description of the turpentine oil test, armed with which he intended to appeal to the American customs authorities again. Another foreign firm wished to ascertain whether its steel hydrogen flasks met the requirements of the German police regulations governing the traffic in liquid and compressed gases. Flasks were sent to Gross Lichterfelde. There it was found that the wrong kind of metal had been employed, and that the police requirements had by no means been fulfilled.

Whenever any department of the German Imperial Government is confronted with a technical problem for solution it is

(Concluded on page 604.)

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The SCIENTIFIC AMERICAN *for* 1912

Magazine Numbers for 1912

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FEBRUARY 10—
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MARCH 16—
Good Roads
APRIL 13—
Science in the Ideal Home
MAY 18—
Our Coast Defenses
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JULY 13—
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AUGUST 17—
Chemistry in the Arts
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Aviation
OCTOBER 12—
Labor-Saving Machinery
NOVEMBER 9—
Invention
DECEMBER 7—
The Panama Canal

AT the close of last year, under the caption of The Greater "Scientific American," the publishers announced that the scope of the paper would be extended; that a series of mid-month numbers of greatly enlarged size, contained in a colored cover, would be issued, the contents being devoted to some special subject of national importance. We also announced that there would be a series of articles written by specialists in their several departments, and that these new features would be accompanied by a general improvement in the typography and make-up of the paper.

¶ The fifty-two issues of the past year speak for themselves; and their favorable reception by our subscribers and the general reading public encourages the publishers to continue the same policy, on even more progressive lines, throughout the year 1912.

Special Contributors

THE high quality of the Scientific American of 1911 will be evident from a study of its list of contributors, conspicuous among whom were President Taft, Secretary G. v. L. Meyer, Admiral A. T. Mahan, the chiefs of the various bureaus, and other high ranking officers of the navy; Secretary Charles Nagel, of the Bureau of Commerce and Labor; The Hon. John Barrett, Director of the Pan-American Union; Commissioner of Navigation E. T. Chamberlain, ex-Chief Forester Gifford Pinchot; Director F. H. Newell of the Reclamation Service; Judge Judson C. Clements, Chairman of the Interstate Commerce Commission; Dr. J. A. Holmes, Director of the Bureau of Mines; Professor Ira Remsen, President of Johns Hopkins University; W. J. Spillman, and other members of the staff of the Department of Agriculture; Robert Kennedy Duncan, S. A. Mitchell, H. N. Russell, H. W. Walker, Moyer S. Fleisher, E. L. Thorndike, T. C. Martin, and W. C. Brown, President of the New York Central Railway Company.

The list of contributors for 1912 will be equally distinguished. It will include the majority of the names above mentioned, together with others of high authority in the various fields that will be covered during the year. The Scientific American will combine to follow closely its avowed policy, as stated at the head of its Editorial Columns: "The purpose of this Journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement."

The Broad Scope of the Paper

THE subjects dealt with in 1912 will come under the heads of civil, mechanical and electrical engineering; naval and military; the merchant marine; the internal combustion motor; chemistry with special attention to electro-chemistry and electro-metallurgy; science as applied to the industries; science in agriculture. There will be the usual amount of space devoted to biography, astronomy, scientific abstracts from current periodicals and archaeology. Under the subject of inventions, particular attention will be given to the leading inventions and to patent practice, with a reference to notable cases, and there will be the usual run of inventors' notes. The popular "Workshop" and "Laboratory" departments will make their regular appearance.

The Panama Canal Number

THE great popularity of our recent Naval Number, which was immediately recognized as a brochure on the navy of unusual authority and information, has decided the publishers to prepare a similar number in December, 1912, on the Panama Canal. The material for this issue will be gathered by our Editor-in-Chief, Mr. J. Bernard Walker, who will spend some time at Panama for the purpose of making a personal inspection of this stupendous work, and securing the necessary plans, photographs and data. The number will contain a complete account of the history, construction, operation, military defenses, and commercial and naval value to the United States of this great national undertaking.

Science in the Industries

AN important feature of the 1912 program will be a series of articles by Mr. Waldemar Kaempffert, Managing Editor of the Scientific American, in which he will sketch the scientific basis of Germany's remarkable commercial success—the object of this series being to offer for the consideration of the American business man certain well-proved methods for increasing the physical efficiency of the workman and the amount and quality of his output. Two of the articles will deal with German education—"The German Commercial High School", which turns out captains of industry, and "The German Vocational School", which turns out soldiers of industry. The series will also include the following articles on the relation of science to industry: "The Royal Laboratory for Testing Materials at Gross Lichterfelde" (published in this issue); "The Utilization of Waste Materials"; "The German Technological Museum at Munich" (the remarkable technological museum in which the visitor is allowed to manipulate, through a crank or other means, an operative apparatus); "The Workingman as a Human Machine"; "The State and the German Laborer"; "City Government as a Science"; and lastly, "The Commercial Utilization of Scientific Discoveries"—a summing up of impressions gleaned from a dozen factories, workshops and cities. These articles will be based upon the facts and impressions gathered by the author during a recent extensive tour of Germany, made for this express purpose.

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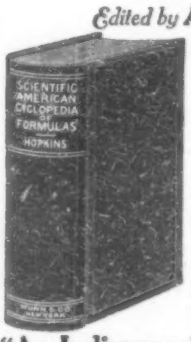

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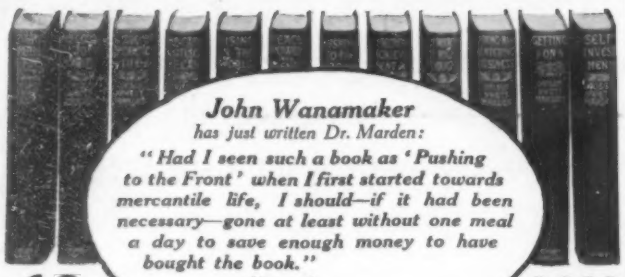

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almost sure to ask Gross Lichterfelde for advice. Thus, for the Royal Powder Works of Spandau, specifications were formulated for the manufacture of machine and cylinder oil, machine greases, linseed oil, turpentine oil and vegetable oils. For the Minister of Public Works a scientific test for distinguishing natural from artificial asphalt was worked out, and a study made of the thermal conductivity of refractory building materials. When the Imperial Printing Office decided to improve the quality of German post cards, Gross Lichterfelde made a study of existing cardboards and papers and practically invented a new composition which would answer modern commercial requirements. Hand in hand with the Artillery Testing Commission, tests were made with copper cylinders for measuring gas pressures. Even the German colonies consult the Laboratory, for the German governor in Togo and Kamerun submitted African woods for comparison with North and South American woods, with the result that in the near future Germany will probably draw upon her African supplies.

The institution at Gross Lichterfelde has a history that extends back to the experiments made by Dr. A. Woehler, an engineer who, in 1863, constructed the first really scientific testing apparatus employed in Germany. But the remarkable place which the institution has won in German industrial life and its world-wide reputation is due almost entirely to its present head, Geheimer Oberregierungsrat, Prof. A. Maartens. When he was appointed to fill the director's chair in 1884 the entire scientific staff of the mechanical-technical department consisted of only three men, and the apparatus of two testing machines. What the development of the Laboratory has been since then may be judged from the highly varied character of the work here outlined. That astonishing development would hardly have been possible had not Maartens himself devised a very large part of the experimental apparatus which constitutes the equipment of the Koenigliches Material-Pruefungsamt.

Methods of Dust Extraction on Cotton-carding Engines

(Concluded from page 593.)

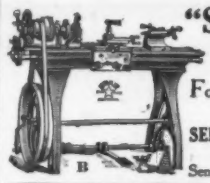
air trunk; this aperture is closed when stripping is not in operation at that machine. The draught is thus concentrated on one machine only. The aperture is automatically opened by the receiver itself as it reaches the machine to be stripped. The appliance is propelled by hand to any part desired by the workman. On arriving at a given machine, the funnel-receiver is brought immediately over the card-cylinder, close by the line where the dust is generated by the stripping-brush, and the indraught collects the dust before it can diffuse.

By a third method (Fig. 5) of dust extraction a vertical tube is provided over each carding-engine, this tube being connected with a casing or "hood," which is lowered to cover the stripping-brush when operating. A sliding shutter is fitted in the vertical tube. This is opened when ready for stripping, all other shutters being then closed. Thus the exhaust from the fan is concentrated on one "card" only. When stripping is completed the hood is raised in the vertical tube.

A fourth method (Fig. 6) has pipes depending from horizontal trunks following the lines of cards; but in each pipe is a patent valve, formed where the pipe can be flexed. When the pipe is vertical the interior is fully open; when flexed as far as possible, the aperture is closed. Hence in all tubes bent, so as to be out of the way of the workers, the valves are automatically closed. To operate this dust-extractor an aluminium cover is provided for each stripping-brush. The outlet pipe of the cover fits into the down-pipe just mentioned, so that when the fan is started the dust is drawn off as stripping proceeds. The power required for an average mill is estimated at about one horse-power.

The method now described (Fig. 7) works on a portable principle. The stripping-brush is inclosed in a hood which has a flexible-tube connection with the dust-extractor. This comprises a portable chamber built on an angle-iron frame, braced with tie-rods and bolts, and having a wooden top and base. The

(Concluded on page 607.)



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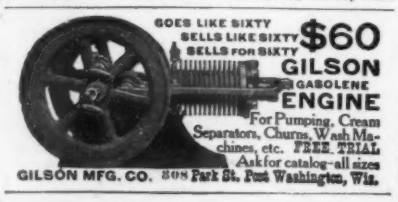

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With the installation of dust-extractors in the card-rooms of cotton mills, the health and working efficiency of the operatives concerned will be considerably improved. Likewise the material produced, in the shape of finished yarn, being free from specks of dust, will be very materially enhanced in its market value.

Telephones in Great Britain

ON December 31st, 1911, the telephone service of the United Kingdom will become, like the telegraph service of that country, a government monopoly.

The history of British telephones is reviewed in a recent report of Consul Rufus Fleming, stationed at Edinburgh. An act of 1869 gave to the Postmaster General the monopoly of operating telegraphs, and in 1880, as a result of the case of the Attorney General vs. the Edison Telephone Company, it was decided that telephones were included in the provisions of this act. However, the government, instead of buying up the patents and taking the telephone service into its own hands, granted licenses to the existing telephone companies. At first the companies were restricted in their operations to limited areas, but from 1884 onward the licenses were applicable over the entire kingdom. This led to the organization of large companies, and by 1892 practically all the business was in the hands of the National Telephone Company, Ltd. In 1896 the government took over the operation of all the trunk lines connecting one town with another, paying the company upwards of $2,233,723. The latter has since continued to operate the local lines, but will transfer all its business to the postoffice at the end of the present year.

There are approximately 644,000 telephones in the United Kingdom, but it is estimated that if the system were used in the same ratio to population as in the United States, the number would be nearly 3,000,000. Judging from the history of the telegraph service, it is expected that the transfer of the telephones to the government will result in a great extension of the system.

A Fiber Exposition in Java

A UNIQUE exhibit of fiber plants and fiber-working machinery has been held at Soerabaya, Java, during the past summer, in connection with the Fiber Congress of the East Indies, which opened July 3rd. Dutch, German, and British machinery was represented, made by Krupp, Benisch, Berand Liebescher, Lees & Co., and Oldham. All the fiber plants of Java, and many from the Philippines, Siam, etc., including sisal, agil, pineapple fiber, banana fiber, coconut fiber, Java cotton, kapok, and others, were exhibited. One exhibit showed the natives of Java working kapok and cotton from the very first stage of preparing the fiber to the finishing of the woven cloth.

Kapok is the silky fiber surrounding the seeds of the silk-cotton tree (*Ceiba pentandra*), one of the noblest trees of the tropics. It is extensively used in stuffing mattresses, and also in filling life-preservers, for which latter use it is especially valuable, as it will support a greater weight in water than any other substance used for this purpose. A mass of pressed kapok will support thirty-six or thirty-seven times its weight.

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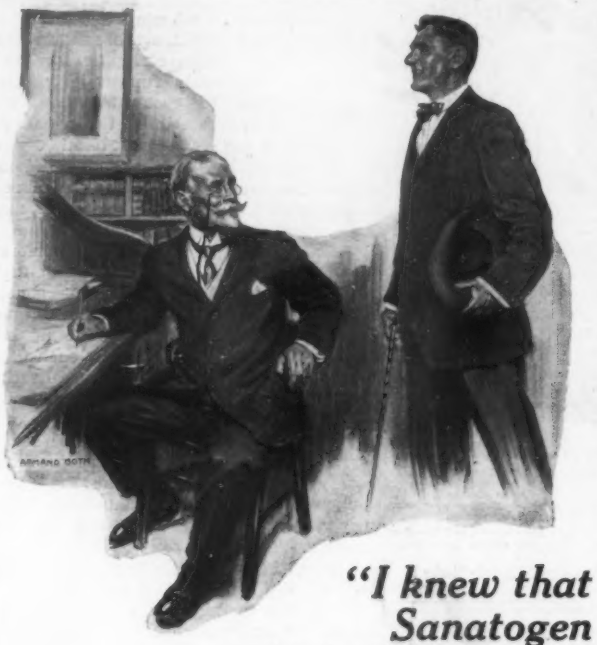

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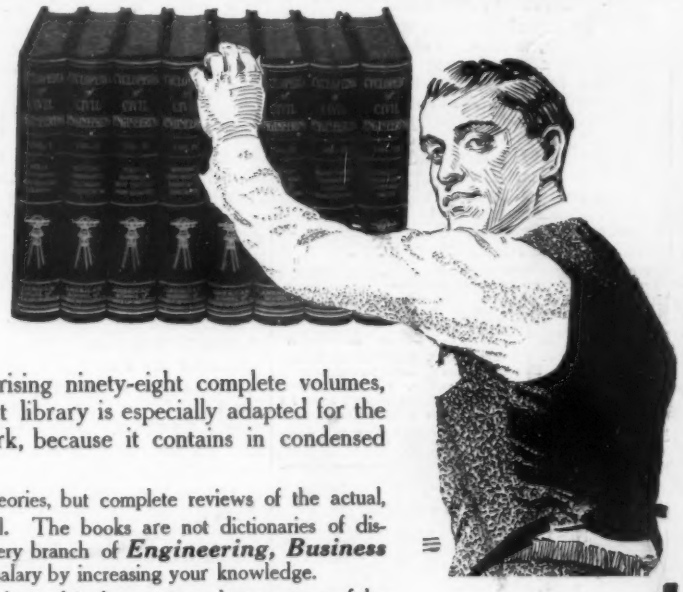

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